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# The Genus *Erythroneura* North of Mexico.

(Homoptera, Cicadellidæ.)

WILLIAM ROBINSON, Department of Entomology.

THE genus *Erythroneura*, which contains the grape leaf hoppers, is well known to both economic and systematic workers. It has been called the most intricate genus in the entire family; it is certainly one of the most interesting. Much has been written about the forms which attack the grape, and their life history and control measures have been well studied. However, strange as it may seem in the case of important economic insects, a good deal of uncertainty and confusion has existed as to the species. In many publications the grape leaf hoppers have been erroneously named and classified, and several distinct species have been called varieties of *comes*. Thus our commonest grape leaf hopper has been credited altogether with as many as twenty varieties. In discussing with economic workers the taxonomic position of the various forms which attack the grape, I have been able only with difficulty to get them to express an opinion at all as to species. I have therefore undertaken to gather together all the known American species, north of Mexico, and to study them from every possible standpoint, as explained later.

The species are numerous, widely distributed and very abundant in individuals. Color pattern is one of their most striking characteristics, comprising a wide range of color, and assuming, in some species, a pattern approaching the bizarre—black spots within red rings upon a white background; zigzag streaks of yellow, red or brown upon white; dots or dashes of red upon ivory; wide cross-bands of velvety black upon white; a large central area of maroon on a background of cream; neat patterns in pink, rose or vermilion upon white or cream; or the color may be brown, red or black with white spots.



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Being of small size, however, they are easily overlooked or neglected. Nevertheless they are far from insignificant in pattern and in their ability to do injury.

In the absence of better external characters, these color patterns have been used to distinguish species. In certain instances this was simple; but in many cases, when using only these characters, it was difficult and almost impossible to make accurate determinations. This is due partly to the variations which were supposed to exist within the species, and to the merging of the color pattern of one species into that of another, thus forming complexes which were exceedingly confusing. Under such circumstances it was impossible for anyone to make an accurate determination of many of the species. In McAtee's revision,[1] the author separated the genus into groups based on characters presented by wing venation. This, despite a certain amount of variation, was a considerable improvement over the old system. However, it was still impossible to say definitely whether forms having slight differences in color pattern were distinct species or merely varieties.

The present work embodies a study of the inner male genitalia, as well as of wing venation and of color pattern, and it is believed that the characters presented by the genitalia, which are practically constant within the species and which have outstanding specific characteristics, will add much to the definiteness of classification. It is interesting to note that in most cases there is a marked correlation of these three factors. For instance, in the *comes* group the vein cubitus turns abruptly toward the inner margin of the wing and thus forms a square base for cell $M_4$. (Plate I.) All species of the *comes* group have this type of venation. Correlated with this is the occurrence in every case of a black dot or cloud in the apex of cell $R_3$ and the base of cell $M_4$. Also the pygofer hooks of the inner male genitalia are bent to form more or less U-shaped processes (Plate I), and are of a shape not found in any species outside this group.

In the *maculata* group cubitus turns forward and forms an oblique base for cell $M_4$. (Plate I.) These species have a black dot in the base of cell $M_4$, the apex of cell $R_3$ is clear; while the pygofer hooks consist invariably of long, spearlike processes.

In the *Obliqua* group the cubitus turns forward, but the base of cell $M_4$ is made up of the m-cu cross-vein along with the bent por-

1. Key to the Nearctic Species and Varieties of *Erythroneura:* Trans. of the Am. Ent. Soc., XLVI, 267-322; 1920.

tion of cubitus, and these two parts are joined together to form a more or less smoothly curving line. In the color pattern may be found oblique vittæ upon the tegmina or an inverted "V" mark on the vertex and pronotum, or both of these characters. The pygofer hooks are short and thick, with an apical point and a ventral stub-like process.

All the North American species which have been described up to the present time, together with a large number of variations, have been studied. Thirty new species have been added to the list and twelve varieties have been given specific rank, based upon the study of their inner male genitalia. The genus now contains sixty-two[2] species and twenty-six varieties.

Acknowledgments are due to Dr. P. B. Lawson, at whose suggestion this work was undertaken and who was ever ready with assistance and advice as the work progressed; to Prof. R. H. Beamer, for collecting a large amount of Kansas material; to Mr. W. L. McAtee, for his kindness in supplying the writer with many species for study and dissection; also to Mr. E. P. Van Duzee, Prof. C. P. Gillette, Dr. D. M. DeLong and Mr. L. Stearns, for sending in material for examination. I have made extensive use of McAtee's original keys to groups and species.

Some notes on the bionomics of the genus, based mostly on personal observations over a period of several years, are here included.

## LIFE HISTORY.

The members of this genus pass the winter as adults. In the Southern states they remain more or less active throughout this period. In Canada and in the Northern and Middle states the adults go into hibernation upon the approach of cold weather, chiefly under the protection of fallen leaves, but they may also be found within clumps of dead grass, under loose bark of trees, under fallen logs, and in decaying tree stumps. A favorite situation seems to be in the deep layers of dead leaves which have been lodged by the wind at the base of trees, stumps and bushes.

An excellent opportunity to study the adults while in their hibernating quarters occurred in Kansas during the winter of 1923-'24. The ground was rarely covered with snow and observations could be made at any time. A study of the effect of rapid changes of tem-

2. Since writing the above, four new species and one new variety have been described by E. P. VanDuzee: Proc. Cal. Acad. Sc., 4th series, vol. XIII, pp. 231-236; 1924; and three new species and four new varieties have been described by W. L. McAtee, Division of Natural History Survey (Illinois), vol. XV, art. II; 1924.

perature upon the adults was possible. Sharp freezing spells of short duration followed by warm, sunny days were of frequent occurrence. At one time the temperature went down to eighteen below zero and within forty-eight hours had risen to forty degrees above. A large percentage of insects of other families and orders which passed the winter in the adult stage were found dead in the spring; but *Erythroneura* wintered well, not more than one in one thousand being found dead.

The adults emerge from their winter quarters and commence to feed in the late spring, the sunshine of early spring not being sufficient to warm through the layers of leaves. In the case of many species, among them the grape leaf hoppers, the emergence of adults in the spring takes place before their host plants have begun to come into leaf, and in the meantime they feed upon a great variety of available plant foliage. This is true of the species in general; and the fact that species are taken on any given plant in the spring and in the late autumn does not imply that that is its host plant.

It is necessary to make some distinction between host plants and temporary food plants. The former are those within which the females lay their eggs and upon which the nymphs as well as the adults feed; the latter are those upon which the nymphs are never found and only the hibernating adults feed in the absence of their host plants. I have taken the grape leaf hoppers on as many as eighty different species of food plants, but have found them breeding on only the grape or allied plants. The injury to the temporary food plants is usually negligible.

Copulation may take place upon the spring food plants and upon the host plants, to the latter of which both males and females proceed shortly after the earliest appearance of the foliage. The eggs are minute, elongate, whitish, and are laid within the tissues of the leaf. They may be scattered or placed side by side in a row, depending upon the species. The nymphs pass through five instars, in common with other members of this family.

By the time the nymphs have reached maturity practically all the overwintering forms have died. The new brood mate, and in the Southern states may produce a complete second brood, while in the North only a partial second brood is produced. In the autumn the host plants may die before cold weather forces the adults into hibernation; and until cold weather appears the hoppers will go to and feed upon a number of available food plants just as in the spring.

In some species and varieties both yellow and red forms occur. The reddish colors develop in the late summer and are retained throughout hibernation. In the following spring after the adults have begun to feed upon the newly formed foliage, the reddish vittæ may turn yellow.

## NATURE OF INJURY.

Both nymphs and adults feed upon the under side of the leaves. They extract juices from the foliage and take along at the same time chlorophyl from the cells. At every feeding place a small white spot appears which is made up of several minute points. Each point represents a feeding puncture and indicates that the hopper inserts and withdraws its mouthparts several times at each feeding place. These spots increase in number and coalesce, making pallid areas which may in time cover the whole surface of the leaf. The puncturing of the epidermis in innumerable places eventually causes a drying up of the leaf tissue, and in the case of serious injury it becomes brown, dry and functionless. This injury to the foliage has a direct effect upon the fruit. In badly infested vineyards there is a marked decrease in the sugar and an increase in the acid content of the fruit; and a decided lowering of the total yield takes place. Also it is not uncommon in the case of red varieties of grapes for the crop to fail to ripen sufficiently to be picked.

The cultivated grape is by far the most important plant attacked by the members of this genus. The following is a list of species and varieties which breed upon the grape:

*E. comes* Say.
*E. comes* var. *octonotata* Walsh.
*E. comes* var. *compta* McAtee.
*E. coloradensis* Gillette.
*E. vitifex* Fitch.
*E. rubra* Gillette.
*E. portea* Robinson.
*E. vulnerata* Fitch.
*E. niger* Gillette.
*E. ziczac* Walsh.
*E. vitis* Harris.
*E. tricincta* Fitch.
*E. illinoiensis* Gillette.
*E. lacta* Robinson.
*E. elegans* McAtee.
*E. maculata* Gillette.
*E. amanda* McAtee.
*E. obliqua* Say.
*E. dorsalis* Gillette.
*E. crevecoeuri* Gillette.

Of these, *ziczac* and *elegans* also breed extensively upon *Ampelopsis* spp. which are of the same family as the grape; and *obliqua* has been found breeding upon both wild and cultivated plums.

## CONTROL.

Control may be readily effected by the use of nicotine-sulphate, such as "Black Leaf 40," applied at the rate of 1-1200 or 1-1600. The spray should be applied to the first brood nymphs before the

most advanced have reached the fifth instar; and, as the nymphs feed upon the under surface of the foliage, especial care should be taken to drench thoroughly the under surface of all the leaves. A short rod with an angle nozzle should be used; the ordinary long rod is very inconvenient to use in a vineyard. The disc in the nozzles should have a medium-sized hole in order to give a dense but not too fine spray; and the pressure should be from 150 to 200 pounds. Thorough drenching is essential, and from 150 to 250 gallons per acre, depending upon the amount of foliage, should be used.

A long series of experiments[3] has shown that this spray will also destroy the eggs beneath the epidermis, so that it is possible to get excellent control by spraying at the time mentioned above and not waiting until all the eggs have hatched. Delaying the treatment will allow many of the nymphs to mature, and these are not readily killed with a spray.

In the South good use is often made of the sticky trap or hopper-dozer, which is passed over the vines and which catches the adults as they fly upward.

It is a good practice in the early spring to burn over fallen leaves and dead grass along ditches, roadsides and neglected places, in the neighborhood of the vineyard. This may destroy large numbers of hoppers since it is in such places that the adults pass the winter.

## COLLECTING.

Winter is a good time for collecting. The favorite place of the adults appears to be, as previously mentioned, among layers of fallen leaves, especially where lodged by the wind against stumps and the bases of trees and shrubs. There the hibernating adults gather in large numbers from their scattered food plants and may be very easily obtained.

There are two or three satisfactory methods of capturing the adults in winter. One is to lift the dried leaves and pick up the dormant insects by the legs with a pair of fine tweezers and put them into a cyanide bottle. Another way is to place the layers of leaves in a fine sieve and shake them over a large funnel into a box or bottle. If this is done on cold days the hoppers will be dormant and fall readily into the container.

In the spring countless numbers of hoppers can be found feeding

3. Susceptibility of Grape Leaf Hopper Eggs to Nicotine: Agricultural Gazette of Canada, vol. X, No. 3; 1923.

upon the foliage of various bushes and low-growing plants in the woodlands. Species of many kinds feed together for several days between the time of emergence from hibernation and the general dispersal to their respective host plants; and it is during this period that the most profitable collecting can be done.

A strong sweeping net of fine close weave attached to a short handle is generally found most satisfactory. Since the hoppers are exceedingly active and readily take flight and dart out of the net, very many may be lost in taking individuals from the net in a small bottle. A better way is to use a net with sides that taper to a point in which the captured adults will fall and remain while the net is in motion. When a number have been caught it is very easy to transfer them altogether by inserting a bottle with a large mouth as far as it will go and shaking the hoppers in. Practically none will escape if handled in that way.

## MOUNTING.

Mounting on a celluloid point with shellac or Canada balsam is sometimes practiced, also on a white card point with shellac or liquid glue. The latter method is probably the most satisfactory. The main consideration is that the specimen be securely fastened to the point. A quick way to mount is to place about one inch apart on a piece of cork several pins bearing their card points which should be turned to the left. The specimen is best picked up by moistening on the tongue a bent needle point mounted in a wooden handle, and touching it to the back of the insect to be mounted. A small drop of liquid glue should then be applied to the point by the left hand and the specimen mounted near the tip. I have found that these insects are much less likely to come off if the glue is applied in each case just before the mounting.

## CLASSIFICATION.

In this classification the venation of the fore wing is used to separate the genus into groups only, no specific venational characters having been found. In naming the veins, the Comstock-Needham system is used.

The genus *Erythroneura* is separated from the genus *Typhlocyba* by $R_{4+5}$ separating from $R_{2+3}$ and meeting media at right angles, so that cell $R_3$ has a distinct base instead of being stalked, and by vein $M_{3+4}$ not proceeding straight to tip of wing but curving to meet the inner margin. (Plate I.)

## INNER MALE GENITALIA.

The outer male genitalia have not been found to show specific characters, but the inner male genitalia have outstanding differences and provide abundant specific characters which are practically constant for the species as shown by the examination of a long series of individuals.

The parts comprising both outer and inner male genitalia are shown in Plate I. The inner genitalia include a pair of pygofer hooks, one of which is partly imbedded in the upper surface of each pygofer near the anal tube; a pair of styles or claspers whose toothed or apical ends project outside the genital chamber; the œdagus; and the connective which unites the œdagus to the styles. Both dorsal and lateral views of these members are shown and also the position which the inner genitalia occupy within the chamber.

## TECHNIQUE FOR PREPARING GENITALIA FOR STUDY.

The most satisfactory method of procedure in preparing specimens for study has been found to be as follows: A number of small vials are numbered and partly filled with a 10 per cent solution of caustic potash. The specimens to be examined are left mounted on their card points and the posterior part of the abdomen is taken off under the binocular and transferred on the moistened tip of a needle to a vial. The specimen on the card point is then given a number corresponding to the one on the bottle. The abdomen is allowed to remain in the cold solution for twenty-four to thirty-six hours. If quicker results are required, heating the solution, but not boiling it, will cut down the time to about half an hour.

A minute pin inserted into a thin wooden handle makes an excellent dissecting point. A device to reach into the bottle and lift out the abdomen without crushing it is made by bending a point of a fine pin to form a minute loop. The stem is then bent at an angle and inserted into a wooden handle.

The tip of the abdomen, after being thoroughly cleared, is transferred to a flat-bottomed watch glass and examined under water with the highest power of the binocular. The abdomen is placed on its side and with strong transmitted light the pygofer hooks can be seen. A drawing of the lateral aspect of the hooks is then made.

In order to get accurate drawings the use of a micrometer disc in the ocular and paper ruled with squares to correspond to the squares in this scale is recommended. The squares on the paper should

measure at least three inches and two of these squares will be enough.

When a lateral view of the pygofer hooks is drawn, the inner genitalia should be very carefully dissected out. The greatest care is necessary to avoid mutilating them, as they are very soft and easily distorted or torn. On the lower surface of the styles near the apical third is a toothed process which is characteristically hidden in some species. If pressure is placed upon the style this tooth may become exposed and may thus destroy the value of that set of genitalia. A drawing of the dorsal aspect of the genitalia is next made as shown in Plate I. The styles should be lying horizontally to give an accurate view. The next step is to draw a lateral view of the connective and œdagus as shown in Plate I. Both outer and inner parts of the genitalia should be preserved in a small vial of alcohol or in a balsam mount.

KEY TO GROUPS.[4]

PAGE

A. M-Cu cross-vein present (Pl. I, fig. 1).
  B. Base of cell $M_4$ curved (Pl. I, fig. 1); two posteriorly diverging vittæ usually present upon vertex and pronotum. *Obliqua* group.. 109
  BB. Base of cell $M_4$ angulate (Pl. I, fig. 3); vertex and pronotum not marked as above.
    C. Light-colored median vitta on vertex, pronotum and scutellum; cross-veins whitish; dark-colored species. *Vulnerata group*.. 115
    CC. Vertex, pronotum and scutellum not marked as above; usually light-colored species. *Scutelleris* group.. 118
AA. M-Cu cross-vein absent,[5] media 3 + 4 and cubitus forming a more or less continuous line (Pl. I, fig. 2).
  B. Base of cell $M_4$ oblique; apex of cell $R_3$ without black spot. *Maculata* group.. 122
  BB. Base of cell $M_4$ square; apex of ecll $R_3$ marked with black spot or cloud. *Comes* group.. 129

## THE *OBLIQUA* GROUP.

This group is characterized by having the base of cell $M_4$ made up of the m-cu cross-vein and part of cubitus, the two parts joining together to form a smoothly curving line. (Pl. I, fig. 1.) The color pattern consists of oblique reddish vittæ which may be fused to make a more or less solid area upon the tegmina, or of an inverted V-shaped mark upon the vertex and pronotum. The pygofer hooks are also very characteristic of this group, being short, thick, pointed at the apical end, and bearing a short stublike process beneath.

4. This and some of the following keys are adapted from those in the work of W. L. McAtee, previously referred to.

5. In both of the following groups abnormal cases occasionally occur where there appears to be a short cross-vein present between media and cubitus. This is caused, presumably, by cubitus and media 3 + 4 not meeting directly and forming a continuous line as is shown in Plate I, figs. 2 and 4. However, upon comparing the different types of venation shown in the plate referred to and the other characters given for the groups, there should be little difficulty in placing correctly any abnormal individuals.

The group contains some species which are very abundant in individuals but they are not in general known to be especially injurious to economic plants. It includes ten species and four varieties.

KEY TO SPECIES.

PAGE

A. Principal color markings on tegmina longitudinal.
  B. Longitudinal vittæ usually narrow and paralleling claval suture.
    C. An inverted V-shaped vitta on vertex and pronotum.
      D. Vittæ on clavus and corium similar in color. *obliqua*.. 110
      DD. Vittæ on clavus and corium dissimilar in color. *torra*.. 113
    CC. Vertex, and sometimes pronotum, dusky.
      D. Tegmina dusky-hyaline, vittæ dark red and somewhat obscured. *kanza*.. 112
      DD. Tegmina yellowish, vittæ plainly visible. *fulvocephala*.. 113
  BB. Longitudinal vittæ fused to form a broad dorsal stripe. *dorsalis*.. 112
AA. Principal color markings on tegmina transverse or covering most of surface.
  B. Markings transverse or covering basal half of tegmina, not back to cross-veins.
    C. Narrow red band across middle; pronotum and scutellum red. *rubroscuta*.. 114
    CC. Red to dusky band across basal half and including scutellum. *crevecoeuri*.. 114
  BB. Color covering most of tegmina back to cross-veins.
    C. Tegmina wholly dark red back to cross-veins, except yellow streak on costal margin; vertex and scutellum dark yellow; pronotum mostly brownish-red. *rubricata*.. 114
    CC. Tegmina otherwise marked.
      D. Tegmina reddish with brownish iridescence, except yellow costal plaque and dusky apical cells. *brundusa*.. 112
      DD. Tegmina nearly to cross-veins pinkish-red to dusky-hyaline with pinkish cast, scutellum and anterior parts yellow or dusky. *abolla*.. 113

*Erythroneura obliqua* Say is a common and distinctive species. It is found in large numbers in the spring, along with several other species, on wild plants growing about woodlands. It, however, does not appear to be injurious to cultivated plants.

Four well-marked varieties occur, and they may be separated by the following key:

KEY TO VARIETIES OF *OBLIQUA*.

PAGE

A. Tegmina whitish-hyaline to yellow throughout, with oblique red vittæ.
  B. Black spots lacking in basal angles of scutellum.
    C. Oblique red vitta on both clavus and corium. var. *obliqua*.. 111
    CC. Vitta on clavus only and so broadened as to give the clavus an almost entirely reddish color. var. *clavata*.. 112
  BB. A conspicuous black spot in each basal angle of scutellum, sometimes adjoining parts smoky. var. *noevus*.. 111
AA. Tegmina clouded with fulvous.
  B. Tegmina with broad longitudinal dusky vittæ; apical cells $M_2$ and $M_4$ abruptly hyaline. var. *electa*.. 111
  BB. Dusky markings in form of cross-bands; apical cells uniformly dusky. var. *fumida*.. 111

## *Erythroneura obliqua* Say.

*Tettigonia obliqua* Say. Jour. Acad. Nat. Sci., Phila., IV, p. 342; 1825. Reprint, Complete Writings, II, p. 259; 1859.

*Color Pattern.* Ground color of vertex, pronotum and scutellum yellow, of tegmina whitish, with the following reddish markings: On vertex and pronotum two posteriorly diverging vittæ, forming an inverted V-shaped mark. Scutellum with a median pale yellow vitta bordered by two reddish lines, tip orange-red. Tegmina with an oblique vitta on clavus and another on corium close to claval suture and a streak along costal margin. Veins irregularly marked with red.

*Inner Male Genitalia.* (Pl. II.)

*Host Plants.* Plum, both wild and cultivated; also grape and apple. Plums seem to be the favorite.

*Distribution.* A common and widely distributed species, being reported from Ontario, Maine, Connecticut, Maryland, South Carolina, Virginia, Ohio, Tennessee, Louisiana, Michigan, Illinois, Iowa, Missouri, Nebraska, Kansas, Colorado, California.

## *Erythroneura obliqua* var. *noevus* Gillette.

*Typhlocyba obliqua* var. *noevus* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 757; 1898.

*Color Pattern.* Similar to typical *obliqua,* except that the scutellum has a black spot in each basal angle and sometimes the tip of scutellum and the posterior margin of pronotum are blackish.

*Distribution.* Ontario, Connecticut, Maryland, Indiana, Illinois, Tennessee, Kansas, Nebraska, Colorado, California.

## *Erythroneura obliqua* var. *fumida* Gillette.

*Typhlocyba obliqua* var. *fumida* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 758; 1898.

*Color Pattern.* Similar to typical *obliqua,* except that it has three broad, dark, transverse bands, one involving the posterior part of the pronotum and anterior part of scutellum; the second across middle of tegmina; the third band very dusky over the cross-veins.

*Distribution.* Connecticut, Maryland, Virginia, Indiana, Illinois, Kansas, California.

## *Erythroneura obliqua* var. *electa* McAtee.

*Erythroneura obliqua* var. *electa* McAtee. Trans. Am. Ent. Soc., XLVI, p. 282; 1920.

*Color Pattern.* "The vittæ on head and pronotum of this variety lack the usual high colors and vary from dull greenish-yellow to slaty; the tegminal vittæ are about typical in form, but are duller red than in variety *obliqua,* and are somewhat obscured by the general duskiness of tegmina, to which, however, the following areas are exceptions: Whitish costal plaques (when developed), two long, triangular areas on inner margin of clavus; and separated very sharply, the clear third and fourth apical cells. General color of body slaty margins of abdominal segments pale greenish-yellow." (McAtee.)

*Distribution.* Virginia, Illinois, Kansas.

## *Erythroneura obliqua* var. *clavata* DeLong.

*Typhlocyba obliqua* var. *clavata* DeLong. Bul. No. 17, vol. V, No. 2, Tenn. State Bd. Ent.; 1916.

*Color Pattern.* "Varying from typical *obliqua* only in coloration. Vertex and pronotum red, anterior margin of each, median line on vertex, and median anterior spot on pronotum yellow. Scutellum and entire claval area bright red, the remainder of elytra uniform yellow to apical area, which is milky white. The red and yellow areas are separated in a sharp line on the claval suture.

"A single specimen was taken at Clarksville, June 29, but is so distinctly marked that it is thought best to class it as a variety." (De Long.)

*Distribution.* Tennessee.

## *Erythroneura dorsalis* Gillette.

*Typhlocyba obliqua* var. *dorsalis* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 757; 1898.
*Erythroneura dorsalis* Lawson. Sc. Bul. Univ. of Kans., vol. XII, No. 1, 1920.

*Color Pattern.* White to yellow, with a broad, median, red or black stripe extending from the tip of vertex to, or nearly to, the dusky apical cells.

*Inner Male Genitalia.* The œdagus differs from all other species in this group in having two pairs of bristlelike structures arising under the base. (Pl. II.)

*Distribution.* Ontario, Connecticut, Maryland, Virginia, North Carolina, Tennessee, Missouri, Illinois, Minnesota, Nebraska, Kansas, California.

## *Erythroneura brundusa* Robinson.

*Erythroneura brundusa* Robinson. Can. Ent., vol. LVI, No. 7, p. 155; 1924.

*Color Pattern.* Vertex red, with anterior margin yellow. Pronotum, lateral and anterior margins yellow; disk smoky, bounded on each side by an oblique maroon vitta. Scutellum brownish-red, with a short white median vitta. Tegmina dark maroon, with bronze iridescence grading down to semihyaline in region of cross-veins. Costal plaque opaque-white. Apical cells dark-smoky.

*Distribution.* Kansas.

## *Erythroneura kanza* Robinson.

*Erythroneura kanza* Robinson. Can. Ent., vol. LVI, No. 3, p. 58; 1924.

*Color Pattern.* Vertex and pronotum smoky-grey to fulvous, with two light red vittæ making an inverted "V." Scutellum red with a brown spot in each basal angle and a white median vitta. Tegmina smoky-hyaline throughout, almost dusky, two dull maroon vittæ each paralleling the claval suture, one on the clavus and the other on the corium; apical cells smoky; cross-veins white.

*Inner Male Genitalia.* The apical tooth on each style is long and incurved. It differs markedly from all other species except *fulvocephala*. In the latter case, however, the tooth is very much longer, and the apical third of the style is noticeably extended laterally. (Pl. II.)

*Distribution.* Kansas, Nebraska.

This species is commonly confused with *obliqua* var. *fumida*. However, it bears no striking resemblances to the latter, which has

smoky cross-bands upon a conspicuous white background, while *kanza* is dusky-hyaline throughout with deep maroon vittæ. In the spring it is exceedingly abundant in Kansas upon wild gooseberry, and it is probably of widespread occurrence.

### *Erythroneura fulvocephala* Robinson.

*Erythroneura fulvocephala* Robinson. Can. Ent., vol. LVI, No. 7, p. 155; 1924.

*Color Pattern.* Vertex smoky-yellow to fulvous, eyes black. Pronotum smoky-grey with two orange vittæ on disk. Scutellum smoky-yellow. Tegmina whitish-hyaline, with a red vitta on each side, and running nearly full length of claval suture.

*Inner Male Genitalia.* The apical tooth of the styles is much longer and the apical third of the styles is more extended than in *kanza*. The connective, œdagus, and pygofer hooks also show distinct dissimilarities. The genitalia of *fulvocephala* are much larger than those of *kanza*. (Pl. II.)

*Distribution.* Kansas.

This species somewhat resembles *obliqua,* but may be separated chiefly by the vertex and pronotum being smoky-yellow to fulvous, while *obliqua* has a reddish inverted V-shaped mark.

### *Erythroneura torra* Robinson.

*Erythroneura torra* Robinson. Can. Ent., vol. LVI, No. 7, pp. 155; 1924.

*Color Pattern.* Vertex and pronotum yellow, with a red median inverted V-shaped vitta. Scutellum, a brown spot in each basal angle; a white median vitta outlined in red. Tegmina hyaline, a broad red vitta on clavus and a pale orange vitta on corium, both paralleling claval suture; costal margin yellowish.

*Inner Male Genitalia.* The apical projection of the œdagus is long, narrow and straight, while in *obliqua,* which this species somewhat resembles in color pattern, the process is short and curved. The styles of the two species also show marked differences. (Pl. II.)

*Distribution.* Kansas.

This species has some resemblances to *obliqua,* but may be separated easily by the fact that *torra* has a broad reddish vitta on the clavus and a narrow pale yellow one on the corium, while with *obliqua* the two vittæ are of the same color.

### *Erythroneura abolla* McAtee.

*Erythroneura abolla* McAtee. Trans. Am. Ent. Soc., XLVI, p. 285; 1920.

*Color Pattern.* "The general color varies from diffuse pinkish-red to dusky-hyaline with a pinkish cast, the color extending to, or nearly to, cross-veins, beyond which the tegmina are hyaline more or less clouded with whitish to dusky; costal plaques whitish opaque. The scutellum and anterior parts in some cases are yellowish, and the red color on tegmina may be almost entirely restricted to the veins, along which it tends to form streaks. Face varying

from yellowish to pinkish red, sometimes with median vitta and underside of vertex paler; legs pale, they and pleura more or less tinged with same color as face; body slaty with margins and incisures of abdominal segments, and genitalia chiefly paler." (W. L. McAtee.)

*Inner Male Genitalia.* The genitalia in general are similar to *obliqua.* However, the apical tooth of the style and the apical extension of the œdagus show some slight differences. (Pl. II.)

*Distribution.* Maryland, Virginia, Illinois, Kansas, California.

This species was placed by McAtee in another group because the base of cell $M_4$ is inclined to be somewhat angulate instead of smoothly curving; however, when the inner male genitalia are studied the fact is at once revealed that *abolla* belongs to this group.

### *Erythroneura rubricata* Van Duzee.

*Typhlocyba rubricata* Van Duzee. Bul. Buf. Soc. Nat. Sc., IX, p. 229; 1909.

*Color Pattern.* Vertex and scutellum dark yellow; pronotum sometimes yellowish on anterior margin, remainder brownish-red. Tegmina reddish to brownish-red, a streak along costal margin, involving costal plague, yellow. Apical cells slightly dusky.

*Distribution.* Florida.

I have not been able to examine the inner genitalia of this species. However, the characters of the wing venation show that it belongs to the *Obliqua* group.

### *Erythroneura rubroscuta* Gillette.

*Typhlocyba rubroscuta* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 755; 1898.

*Color Pattern.* Vertex pale yellow, usually with red spot at tip. Pronotum mostly reddish, with a yellow spot on middle of anterior margin. Scutellum red. Tegmina whitish-hyaline, with a red band across the apical third on clavus to, or almost to, costal plaque. A red streak on costal margin near base and on cross-veins.

*Inner Male Genitalia.* The œdagus is elongate and slender throughout, and the apical process is long and upward curving; the apical third of the style is stout and has a forward projecting tooth. (Pl. II.)

*Distribution.* Ohio, Illinois, Kansas.

### *Erythroneura crevecoeuri* Gillette.

*Typhlocyba crevecoeuri* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 767; 1898.

*Color Pattern.* Vertex and pronotum pale yellow, with a reddish inverted V-shaped mark. Scutellum dark red. Tegmina, basal two-thirds deep red with middle portion often dusky, apical third pale yellow. Cross-veins and adjacent parts of longitudinal veins sometimes red.

*Inner Male Genitalia.* The apical third of the style is attenuate; the œdagus is slender and trifurcate at the apical end. (Pl. II.)

*Distribution.* New York, Connecticut, North Carolina, Ohio, Kansas.

## THE *VULNERATA* GROUP.

In this group the base of cell $M_4$ is angulate; all the species have a light-colored median vitta upon the vertex, pronotum and scutellum; the cross-veins, and frequently the adjacent parts of longitudinal veins, are whitish; and the species are all dark colored. There are four species and three varieties in this group.

### KEY TO SPECIES.

| | | PAGE |
|---|---|---|
| A. | Color of upper surface ranging from greenish-brown to brownish-maroon, not blackish. | |
| B. | Markings in basal half of tegmina orange, in apical half light yellow; median vitta inconspicuous, light spots on margin of pronotum. *gradata*.. | 117 |
| BB. | Markings otherwise. | |
| C. | Dorsum deep brown with small conspicuous grey spots; large black area in each basal angle of scutellum. *pulchella*.. | 117 |
| CC. | Dorsum greenish-brown, brown or maroon. *vulnerata*.. | 115 |
| AA. | Dorsum very dark to black throughout. *niger*.. | 116 |

*Erythroneura vulnerata* Fitch, while found commonly on the grape, is seldom abundant enough to be considered a serious pest. The nymphs in the early stages are conspicuously colored with bright orange upon a creamy ground color, and in the later stages they become deep red. The nymphs feed with the tip of the abdomen turned upward. The adults are often found on the upper surface of the grape foliage, and this distinguishes them generally from the other species. Their darker color harmonizes with that of the foliage and renders them less conspicuous.

### KEY TO VARIETIES OF *VULNERATA*.

| | | PAGE |
|---|---|---|
| A. | Tegminal color markings chiefly smoky-brown to black, pale areas conspicuous by contrast. var. *decora*.. | 116 |
| AA. | Tegminal color markings otherwise, pale areas less conspicuous. | |
| B. | Markings of scutellum and anterior parts about the same color as those of tegmina. *vulnerata*.. | 115 |
| BB. | Markings of scutellum and anterior parts smoky to black, of tegmina vivid maroon. var. *fulmina*.. | 116 |

### *Erythroneura vulnerata* Fitch.

*Erythroneura vulnerata* Fitch. N. Y. St. Cab. Nat. Hist., pp. 62, 63; 1851.

*Color Pattern:* Ground color greenish-brown to fulvous or maroon, relieved by the following pale areas: a median vitta more or less continuous over vertex, pronotum and scutellum; a vitta bordering each eye. Pronotum with two or more spots on each side. Tegmina with whitish spots on clavus and corium; costal plaque yellow with an oblique black mark at each end. Cross-veins and adjacent parts of longitudinal veins whitish. Apical cells smoky.

*Inner Male Genitalia.* The pygofer hooks are weakly bifurcate at the apex and have a prominent ventral stub; dorsally, the œdagus bears three prominent teeth, one straight and two strongly curved. (Pl. III.)

*Host Plants.* Grape, cultivated and wild; *Clematis* spp., *Ampelopsis* spp.

*Distribution.* Occurs in Ontario and Quebec, Canada; and widely distributed throughout the United States.

## *Erythroneura vulnerata* var. *fulmina* McAtee.

*Erythroneura vulnerata* var. *fulmina* McAtee. Trans. Am. Ent. Soc., XLVI, p. 274; 1920.

*Color Pattern.* "Scutellum and anterior parts with color markings chiefly smoky to black, pale areas much reduced; tegmina with ground color opaque whitish, color markings pinkish to maroon, ground color of apical cells black. A most beautiful variety, the dark fore and hind parts contrasted with the paler mid-section, the latter in turn colored with beautifully contrasting milky white and dark red, the costa flushed and the sectors and first cross-vein dotted with bright pinkish red." (W. L. McAtee.)

*Distribution.* Maryland, Kansas.

## *Erythroneura vulnerata* var. *decora* McAtee.

*Erythroneura vulnerata* var. *decora* McAtee. Trans. Am. Ent. Soc., XLVI, p. 274; 1920.

*Color Pattern.* "Color markings smoky to black, pale areas conspicuous by contrast, and much larger than in variety *vulnerata,* vertex pale yellow with two broad black vittæ inclosing a narrow median pale one, pronotum with median and two discal pale yellow spots, sometimes merged, spots and dashes of same color near lateral and anterior margins; median scutellar vitta broad, and basal triangles paler within; tegminal pale areas large, that on base of clavus conspicuous, pale yellow; costal plaque pale yellow." (McAtee.)

*Distribution.* Maryland.

*Erythroneura niger* Gillette, placed as a variety of *vulnerata,* has been found by the study of its inner male genitalia to be a distinct species; *vulnerata* var. *nigerrima* McAtee belongs to this species.

KEY TO VARIETIES OF *NIGER.*

| | | PAGE |
|---|---|---|
| A. | Clavus with a single whitish yellow basal spot. | *niger*.. 116 |
| AA. | Clavus without a large yellow basal spot. | var. *nigerrima*.. 117 |

## *Erythroneura niger* Gillette.

*Typhlocyba vulnerata* var. *niger* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 765; 1898.

*Typhlocyba nigridorsum* DeLong. Bul. 17, vol. V, No. 2, Tenn. State Bd. Ent.; June, 1916.

*Erythroneura nigra* Lawson. Sc. Bul. Univ. of Kans., vol. XII, No. 1; 1920.

*Color Pattern.* Color dark brown or black, with the following white markings: Vertex, pronotum and scutellum each with a pale median vitta, the first two sometimes reduced to discal spots. Tegmina, a large spot on inner margin at base of clavus; other pale areas much reduced. Cross-veins broad and pale.

*Inner Male Genitalia.* The pygofer hooks consist of a sharp process of medium length with a very broad and heavy base, which is unlike the hooks of the other species. The œdagus shows marked dissimilarities and the genitalia in general differ considerably from those of the other species of this group. However, *niger* shows a relationship in the matter of color pattern and wing venation. (Pl. III.)

*Distribution.* New York, Connecticut, Maryland, Virginia, Tennessee, Illinois, Iowa, Nebraska, Kansas, Colorado.

This species and its variety can be distinguished by their dark, almost black, coloration. It probably breeds upon the grape.

### *Erythroneura niger* var. *nigerrima* McAtee.

*Erythroneura vulnerata* var. *nigerrima* McAtee. Trans. Am. Ent. Soc., XLVI, p. 275; 1920.

*Color Pattern.* "A darker form even than variety *niger*, the pale areas on clavus being smaller, semi-hyaline and inconspicuous; in extreme examples there is only a single pale point at two-thirds length of clavus, and one on corium near it, besides the pale yellow costal plaque and paler costal area just posterior." (W. L. McAtee.)

*Distribution.* Maryland, Virginia, Illinois, Iowa, Kansas, Colorado.

### *Erythroneura gradata* Robinson.

*Erythroneura gradata* Robinson. Can. Ent., vol. LVI, No. 3, p. 58; 1924.

*Color Pattern.* Vertex and pronotum yellow, with sometimes an elongate red vitta on each side of a pale median line. Scutellum yellow with paler median vitta. Tegmina, ground color white-hyaline, basal half of clavus red except a mark resembling an inverted comma at inner basal angle; an irregular orange-red area on corium extending from humerus half the length of claval suture; apical third of clavus and the veins up to the whitish cross-veins light orange yellow; a smoky area extending from the tip of cell $R_3$ to the base of cells $M_2$ and $M_4$; costal plaque yellow to white with posterior oblique dark line.

*Inner Male Genitalia.* The apex of the pygofer hooks is strongly and widely bifurcate; the ventral stub is absent; and the base is broad, flat and obliquely inclined. (Pl. III.)

*Distribution.* Kansas, Colorado.

In *gradata*, the anterior median light vitta is less conspicuous than in the other species, and frequently there is a reddish vitta on each side. The red coloration of the basal part of the tegmina becomes orange to yellow beyond the clavus. However, this species is easily separated on the above characters from *vulnerata* which it most nearly resembles.

### *Erythroneura pulchella* Robinson.

*Erythroneura pulchella* Robinson. Can. Ent., vol. LVI, No. 7, p. 155; 1924.

*Color Pattern.* Vertex light brown, with anterior margin, a median vitta enlarged at each end, and a lateral spot opposite each eye, yellowish; all these marks outlined in dark brown. Pronotum light brown, with a blackish ring on disk and two grey spots on posterior margin; five gray spots outlined in dark brown arranged around lateral and anterior margins. Scutellum light brown, with a black triangular spot in each basal angle and a median white vitta outlined in brownish-red. Tegmina, clavus chocolate-maroon except two spots near base and one in apical third greyish; corium grey, with dashes of brown between the longitudinal veins, the latter of which are whitish dotted with

red; costal plaque whitish on inner and red on outer margins and having a black streak at each end; cross-veins and apical veins pinkish-white; apical cells smoky-brown.

*Distribution.* Kansas.

## THE *SCUTELLERIS* GROUP.

In this group there is a wide range of color pattern, but all agree in not having a pale median vitta upon the vertex, pronotum and scutellum, and all are much lighter colored species than in the previous group. The cross-veins are also not conspicuously whitish. It is a rather heterogeneous group, and contains all those species having the base of cell $M_4$ angulate and not included in the *vulnerata* group.

### KEY TO SPECIES.

| | | PAGE |
|---|---|---|
| A. | Apical cell $M_4$ bearing a black cloud or dot at base. | |
| B. | Tegmina brilliant red with a large white discal area. *hartii*.. | 119 |
| BB. | Tegmina colored otheriwse. | |
| C. | Vertex and scutellum conspicuously spotted with red or black. | |
| D. | Spots red, single; chief color markings of tegmina black dots. *illinoiensis*.. | 119 |
| DD. | Spots black, double; tegmina brownish with whitish areas. *tecta*.. | 121 |
| CC. | Vertex and scutellum not as above. | |
| D. | Principal markings two conspicuous black bands, one across pronotum and the other at base of apical cells. *morgani*.. | 119 |
| DD. | Principal markings otherwise. | |
| E. | Scutellum and most of pronotum smoky-brown or black, remainder whitish-yellow with red or yellowish markings. *scutelleris*.. | 118 |
| EE. | Scutellum and pronotum not smoky-brown or black. | |
| F. | Color pattern rose (sometimes dusky) throughout and covering most of tegmina. *rosa*.. | 120 |
| FF. | Color pattern bright red on anterior half and orange on posterior and occurring as more or less isolated areas. *rubraza*.. | 121 |
| AA. | Apical cell $M_4$ without a black cloud or dot at base. | |
| B. | Entire upper surface pale yellow. *ador*.. | 120 |
| BB. | Upper surface otherwise. | |
| C. | Vertex and scutellum each with two distinct black spots. *bipunctata*.. | 121 |
| CC. | Color pale yellow with orange-yellow vittæ; female genital plate produced and notched. *dentata*.. | 120 |

### *Erythroneura scutelleris* Gillette.

*Typhlocyba comes* var. *scutelleris* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 764; 1898.

*Color Pattern.* Vertex varies from reddish with five yellow spots to dusky-yellow. Pronotum varies from yellow with reddish markings anteriorly and smoky-brown posteriorly to deep brown throughout, with a small yellow dot on middle of anterior margin. Scutellum smoky-brown to black. Tegmina, whitish-hyaline or yellow, with the following red markings: Three spots on clavus, the first two sometimes joined to form a barbed vitta, spots on corium irregularly arranged around the costal plaque. Cross-veins and adjacent parts of longitudinal veins reddish.

*Inner Male Genitalia.* The pygofer hooks are long and slender and have a stout tooth at the apical end. (Pl. IV.)

*Distribution.* Connecticut, Maryland, Virginia, Tennessee, Ohio, Missouri, Kansas.

## *Erythroneura morgani* DeLong.

*Typhlocyba morgani* DeLong. Bul. 17, vol. V, No. 2, p. 104, Tenn. State Board of Entomology; 1916.

*Color Pattern.* "Pale yellowish, eyes pale fuscous, pronotum with a rather broad brownish-black band across posterior two-thirds; disk, anterior margin before it, and a point behind either eye whitish. Elytra pale, marked with slightly darker yellow spots, and a broad band before nervures of apical cells, brown. Beneath pale." (D. M. DeLong.)

*Inner Male Genitalia.* The pygofer hooks are elongate, slightly curved and sharply toothed apically; and there are two widely separated fingerlike processes at the base. The styles are very slender apically with a long drawn-out tooth which bends midway to form a right angle. (Pl. III.)

*Distribution.* Maryland, Ohio, Tennessee, Illinois, Kansas.

## *Erythroneura hartii* Gillette.

*Typhlocyba hartii* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 754; 1898.

*Color Pattern.* Vertex, pronotum and scutellum pale yellow to white, sometimes with faint orange marks. Tegmina brilliant red to cross-veins except a large discal spot of ivory-white, and dashes of white on costal margin. Apical cells yellowish-white.

*Inner Male Genitalia.* The pygofer hooks are spearlike with two closely approximated fingerlike processes at the base. The œdagus bears a dorsal projection with three sharply pointed teeth. (Pl. III.)

*Host Plants.* It is reported as being a pest of young apple trees.

*Distribution.* Connecticut, Pennsylvania, Virginia, Indiana, Illinois.

## *Erythroneura illinoiensis* Gillette.

*Typhlocyba illinoiensis* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 758; 1898.

*Color Pattern.* Vertex, pronotum and scutellum white to yellowish-white and each bearing a large red spot. Tegmina whitish-hyaline to yellow, with a large black spot on the corium nearly midway along the claval suture. Frequently this spot outlined in red, and with red dots at base of the corium, base and tip of clavus, and streaks along the longitudinal veins. A black dot at the apex of the costal plaque and in the base of cell $M_4$.

*Inner Male Genitalia.* (Pl. III.)

*Host Plants.* Grapes, both wild and cultivated.

*Distribution.* New York, Connecticut, Maryland, Virginia, North Carolina, Tennessee, Indiana, Michigan, Illinois, Mississippi, Kansas.

## *Erythroneura rosa* Robinson.

*Erythroneura rosa* Robinson. Can. Ent., vol. LVI, No. 3, p. 58; 1924.

*Color Pattern.* Vertex dull red, with two yellow spots on anterior margin and three on posterior. Pronotum slaty to maroon, three pallid spots on anterior margin, the two outer ones being longer than the inner; discal area slaty. Scutellum light yellow with basal angles brown and tip red. Tegmina whitish-hyaline with the following color pattern: Whole of clavus pale rose, except a white area at the inner basal angle adjoining tip of scutellum and one in posterior third but not involving the tip; in the middle of clavus the color sometimes darker red. This coloration extends across corium to the yellow costal plaque in a broad band about as wide as long from which a narrow oblique streak extends back to cells $M_4$ and $M_2$. Base of apical cells smoky; a dark spot in apex of costal plaque.

*Inner Male Genitalia.* The pygofer hooks extend downward from their point of attachment, bend to form a right angle and end in a long slender spine. The styles are attenuate apically and have a short tooth which is not readily seen. (Pl. III.)

*Host Plants.* This species appears to be common on nettles (*Urtica gracilis*), which may be found to be its host plant.

*Distribution.* Missouri, Kansas.

## *Erythroneura ador* McAtee.

*Erythroneura ador* McAtee. Notes on Nova Scotian Eupterygid Leaf-hoppers, including descriptions of two new species. Can. Ent. XXIX, No. 9, p. 361; Nov., 1918. (Halifax, Nova Scotia.)

*Color Pattern.* "An unusually large species for the genus, with long but blunt vertex and long and wide fourth apical cell, angulate at base. Color pale yellow, tegmina varying through greenish to golden-yellow, paler apically; costal plaques somewhat denser yellow; eyes brownish-yellow; clavus dark." (McAtee.)

*Distribution.* Nova Scotia.

I have not been able to examine the genitalia of this species.

## *Erythroneura dentata* Gillette.

*Typhlocyba dentata* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 765; 1898.

*Color Pattern.* ". . . (vertex) pale yellow and having two illy defined orange or lemon-colored spots which, in one specimen, extend forward over the crest of the vertex. Pronotum pale yellow, with two rather large and approximate orange-colored spots just before the middle. Scutellum light yellow on the middle, but more or less washed with orange on all the angles. Elytra light yellow, subhyaline on the basal portion, transparent beyond the cross veins and with two orange vittæ, one on the clavus and another longitudinal one on the middle of the corium and reaching to the cross veins. . . . The last ventral segment of the female has a large broad tooth notched at the tip. . . . The orange coloration is quite faint in two of the specimens." (Gillette.)

*Distribution.* Illinois, California.

I have not been able to examine the genitalia of this species.

## *Erythroneura bipunctata* Gillette.

*Typhlocyba bipunctata* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 751; 1898.

*Color Pattern.* "Vertex red, with two conspicuous black spots a little before the middle surrounded by a narrow band of pale yellow; length about one-third greater at the middle than at the eyes. Pronotum red, with four small pale spots on the anterior margin, posterior margin straight. Scutellum red, with a black spot on each basal angle and with pale coloration margining these spots and upon the apex. Elytra red with a line on claval suture and one on the corium beneath white, beyond cross nervures smoky subhyaline, nervures red." (Gillette.)

*Inner Male Genitalia.* The apex of the styles is unusually short, and the part which precedes it is especially broad. The connective and the œdagus are very heavy. The pygofer hooks arise from a heavy base and turn abruptly upward. (Pl. IV.)

*Distribution.* Texas, Arizona.

Individuals of this species occur with the markings smoky-brown or greenish-yellow instead of red.

## *Erythroneura rubraza* Robinson.

*Erythroneura rubraza* Robinson. Can. Ent., vol. LVI, No. 12, p. 291; 1924.

*Color Pattern.* Vertex ivory on anterior margin, remainder red and inclosing three ivory spots. Pronotum, ivory on anterior margin, remainder white; a red discal area with two anterior projections of yellow, and a small lateral spot of red behind each eye. Scutellum yellow, with a red spot in each angle. Tegmina whitish-hyaline and marked as follows: A red spot at base of clavus, another at tip and a narrow band of same color across middle; a red spot at base of corium, and a red line beginning in front of costal plaque proceeding obliquely inward, where by a short extension it touches middle of claval suture; the line then becomes faint orange and proceeds backward between media and cubitus the length of the costal plaque, where it increases greatly in width and covers remainder of tegmina to cross veins with a faint wash of orange, which is especially noticeable on the longitudinal veins. The costal margin and radius are bright red. A small black spot posterior to costal plaque and a large one in base of cell $M_4$.

*Inner Male Genitalia.* The pygofer hooks are very long and slender, with a shorter hook arising ventrally from the basal third. The connective is narrow at the base and broadens greatly toward the apex of each arm. (Pl. III.)

*Distribution.* Kansas.

*Erythroneura tecta* McAtee is "a very distinctly marked species, larger than most of the genus, with bluntly rounded vertex, swollen face, pronotum decidedly arcuate posteriorly, clavus distinctly roof-shaped, the part within claval (second anal) vein lying horizontally, when tegmina are closed, and that without sloping sharply; fourth apical cell angulate; ventral plate of female arcuate laterally, much produced medianly, this process more or less split longitudinally." (McAtee.)

KEY TO VARIETIES OF *TECTA*.

| | | PAGE |
|---|---|---|
| A. | Averaging larger (2.9 to 3.46 mm.); pronotum and scutellum chiefly yellow; tegmina usually with considerable red markings. | var. *tecta*.. 122 |
| AA. | Averaging smaller (2.64 to 2.97 mm.); pronotum and scutellum chiefly dusky; tegmina with few or no red markings. | var. *carbonata*.. 122 |

## *Erythroneura tecta* var. *tecta* McAtee.

*Erythroneura tecta* var. *tecta* McAtee. Trans. Am. Ent. Soc., XLVI, p. 289; 1920.
*Erythroneura sexpunctata* Malloch. Bul. Brook. Ent. Soc., 16, p. 25; 1920.

*Color Pattern.* "Ground color of scutellum and anterior parts pale yellow; vertex with two round dusky spots on disc which are more or less connected with each other, with inner side of orbits, and with posterior margin by arcuate reddish markings; pronotum with an angulate brown vitta, sometimes broken up into dusky spots on each side, and two discal spots sometimes concealed by reddish markings, which when fully developed form a "U" based on posterior margin; scutellum with basal triangles black, margins and apex reddish; tegmina whitish-hyaline (dorsal pale areas more or less opaque); clavus is perhaps best described by saying it is red, sometimes brownish, except the whitish-hyaline extreme base, a large more opaque whitish or pale yellow area near scutellum and entirely within claval (second anal) vein, a smaller whitish area overlapping apex of last but entirely outside claval vein, and a small transverse whitish band just before apex; corium more or less bluish or dusky between veins, the veins often reddish; two whitish areas bounded by red between third sector and claval suture, costal plaque pale yellow, more or less overlaid by opaque white, bounded at both ends by dusky clouds, costa hyaline posteriorly, interrupted by red cross-vein; apical cells fumose, with a darker area at base of fourth cell and another at apex of wing, common to second and third cells, often forming an oblique vitta. Face pale yellowish, a dark spot on base of clypeus, two others above just within antennal bases, lower surface of vertex marked by a few reddish lines; legs pinkish livid, body slaty, or with pale yellowish edgings." (W. L. McAtee.)

*Inner Male Genitalia.* The pygofer hooks consist of a broad, heavy base and a slender apically projecting spine much like those of *niger*. (Pl. IV.)

*Distribution.* Maryland, Illinois.

## *Erythroneura tecta* var. *carbonata* McAtee.

*Erythroneura tecta* var. *carbonata* McAtee. Trans. Am. Ent. Soc., XLVI, p. 289; 1920.

*Color Pattern.* "A smaller, dusky form, the scutellum and pronotum especially being much darker than in the typical variety, the tegmina with much less red, the tip of clavus and margin of pale spot near base of clavus, however, sometimes red." (McAtee.)

*Distribution.* Maryland.

## THE *MACULATA* GROUP.

In this group cubitus turns abruptly forward in the region of the "cross-veins," and thus forms an oblique base for cell $M_4$. This cell always bears a black spot in the base. In cell $R_3$ a black spot is lacking, and this serves partly to separate this group from the *comes* group. The pygofer hooks are long and spear-like.

KEY TO SPECIES OF *MACULATA* GROUP.

PAGE

A. Color pattern made up chiefly of yellow to red spots; black dot in base of cell $M_4$ large and conspicuous.
  B. Ground color of dorsum deep ivory; spots very dark red. *maculata*.. 123
  BB. Ground color of tegmina light yellow to hyaline; spots light red to yellow.
    C. Tegmina hyaline; spots small, very faint red and lacking a definite outline. *hymac*.. 126
    CC. Tegmina yellowish-white; spots larger and with definite margins.
      D. Spots light orange to yellow; area in middle of clavus tends to be rectangular; color pattern confined chiefly to tegmina. *lawsoni*.. 125
      DD. Spots bright red; mid-claval area concave on anterior and convex on posterior margins; scutellum and anterior parts marked with red. *mediana*.. 126

AA. Color pattern made up chiefly of red zigzag vittæ or of conspicuous red to smoky bands across clavus and corium; black dot in base of cell $M_4$ usually small and inconspicuous.
  B. Pattern chiefly transverse band or bands.
    C. Cross bands three in number, black, involving base, middle and apex of tegmina, respectively. *trivittata*.. 127
    CC. Cross band one in number.
      D. Band very broad, chiefly smoky-brown and covering scutellum and basal half of tegmina, sometimes involving most of pronotum. *basilaris*.. 127
      DD. Band narrower and red; not involving scutellum and pronotum.
        E. Band brilliant red across basal third of tegmina; other coloration pale yellow. *osborni*.. 126
        EE. Band very faint red and crossing tegmina near middle of clavus; other coloration consists of pink marks upon a white ground color. *univittata*.. 127
  BB. Pattern chiefly zigzag vittæ.
    C. Vittæ scarlet; of nearly uniform width; continuous from scutellum to cross-veins; tip of clavus lacking a red spot; tegmina semi-hyaline; other color markings much lighter than main vitta. *ligata*.. 128
    CC. Vitta light red; not of uniform width; obviously made up of several vittæ more or less joined together; red spot near tip of clavus; tegmina opaque-white; other color markings of same color as main vitta.
      D. Vittæ very broad, especially from middle of clavus to costal plaque; practically one continuous line from scutellum to cross-veins. *torella*.. 125
      DD. Vittæ narrower; usually disconnected at claval suture and before cross-veins into three vittæ, one on basal half of clavus, one on disk of corium and one before cross-veins. *campora*.. 124

*Erythroneura maculata* Gillette is one of the species which breeds on the grape. It is a fairly common form, but not so numerous as some of the other grape leaf hoppers, and is not mentioned as being an injurious species.

In this and the following keys I have not included the colorless varieties described by McAtee. It is probable they were newly matured individuals and were captured and killed before their color appeared, which requires a period of several hours after the final molt.

KEY TO VARIETIES OF *MACULATA*.

PAGE

A. Spots on clavus and corium uniformly dark red and of nearly equal size, no part standing out conspicuously. *maculata*.. 124

AA. Clavus with conspicuous red patch or band sometimes extending over the adjacent parts of corium.

B. Anterior two-thirds of clavus red. var. *bella*.. 124

BB. Middle of clavus with a red band which sometimes passes more or less continuously across corium. var. *era*... 124

## *Erythroneura maculata* Gillette.

*Typhlocyba comes* var. *maculata* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 764; 1898.

*Color Pattern.* General ground color ivory to white, with the following markings in red: Vertex, an irregularly shaped vitta whose arrangement tends to inclose from one to three ivory spots. Pronotum, two lateral and one discal spots. Scutellum, a triangular outline in each basal angle, a spot at tip. Tegmina, on clavus a spot at base, middle and tip, the first two sometimes joined together; on corium, a spot at base, before costal plaque, between plaque and claval suture, and at apex of claval suture. Streaks along cross-veins and adjacent parts of longitudinal veins; apical cells hyaline; a black spot in base of cell $M_4$.

*Inner Male Genitalia.* The pygofer hooks in this species consist of two long projections, the lower one slightly the longer of the two. There is a long blunt tooth at the apex of the styles. (Pl. V.)

*Host Plants.* Grapes, wild and cultivated.

*Distribution.* Ontario, Connecticut, Maryland, Virginia, Georgia, Illinois, Wisconsin, Nebraska, Kansas, Texas.

## *Erythroneura maculata* var. *bella* McAtee.

*Erythroneura maculata* var. *bella* McAtee. Trans. Am. Ent. Soc., XLVI, p. 300; 1920.

*Color Pattern.* "Like the red form of var. *maculata,* except that the anterior two-thirds of the clavus and sometimes a spot on adjoining corium is red." (McAtee.)

*Distribution.* Maryland.

## *Erythroneura maculata* var. *era* McAtee.

*Erythroneura maculata* var. *era* McAtee. Trans. Am. Ent. Soc., XLVI, p. 299; 1920.

*Color Pattern.* "Middle of clavus has a distinct red band, which is extended more or less continuously across corium to front of costal plaque; subsidiary tegminal markings red." (McAtee.)

*Distribution.* Virginia, Illinois.

## *Erythroneura campora* Robinson.

*Erythroneura campora* Robinson. Can. Ent., vol. LVI, No. 3, p. 59; 1924.

*Color Pattern.* Vertex red, with five white spots which tend to be arranged as follows: two on anterior margin, two on posterior, and one central. Ground color of pronotum, scutellum and tegmina creamy white, with the following red marks: On pronotum a Y-shaped median vitta with heavy base, a spot on each side; scutellum, three triangular spots, one in each angle; tegmina, in

basal half of clavus an oblique vitta which is enlarged caudally to face the tegminal suture, near tip a spot, a spot on corium near humeral angle, a more or less continuous semi-circular vitta bordering the inner margins of the costal plaque and extending to the base of cell $M_4$. Cross-veins and adjacent parts of longitudinal veins red. A black spot in apex of costal plaque and another in base of cell $M_4$.

*Inner Male Genitalia.* The pygofer hooks consist of a single long spear-like process. (Pl. V).

*Distribution.* Ontario, New York, Arkansas, Kansas, Nebraska.

This species is frequently confused with *maculata;* however, the inner male genitalia prove it to be a distinct species. It is easily distinguished by a white instead of ivory ground color, and the markings being light instead of dark red, and elongate instead of broken up into spots.

## *Erythroneura torella* Robinson.

*Erythroneura torella* Robinson. Can. Ent., vol. LVI, No. 7, p. 156; 1924.

*Color Pattern.* Ground color of vertex, pronotum and scutellum yellowish, with the following marks in crimson: Vertex, an oval outline on disk with an extension on each side to meet the eye. Pronotum, a median Y-shaped vitta whose arms enclose a yellow circular spot, a lateral streak behind each eye. Scutellum, a triangle in each basal angle and a spot at tip. Tegmina whitish, with the following marks in orange-red: A broad vitta with caudal barb occupying basal half of clavus, and a spot at tip; a spot in base of corium; a mark arising at base of costal plaque, continuing around the inner margin to the apex where it extends inward to the base of cell $M_4$, then curves outward again to the crimson radius. A small dot in base of cell $M_4$.

*Inner Male Genitalia.* The pygofer hooks have a terminal tooth which is characteristically downward turned. The connective is much swollen at the apex of each arm, the remainder unusually slender. The apex of the styles is attenuate and bears a long tooth. (Pl. IV.)

*Distribution.* Kansas.

## *Erythroneura lawsoni* Robinson.

*Erythroneura lawsoni* Robinson. Can. Ent., vol. LVI, No. 3, p. 59; 1924.

*Color Pattern.* Vertex, pronotum and scutellum pale yellow, with the following white markings: Two spots on posterior margin of vertex close to the eyes, a median vitta on disk; a large spot on middle of anterior margin of pronotum and a lighter one on each side, posterior margin whitish; scutellum, a median vitta sometimes not reaching the tip. Tegmina, ground color creamy white with orange markings as follows: On clavus a small spot near base, an almost square area in basal third, and a small spot near tip; on corium an oblique vitta in front of costal plaque, an irregular area between the latter and the clavus; some irregular streaks in front of the red cross-veins. A small black dot in the apex of costal plaque and a conspicuous black spot in base of cell $M_4$.

*Inner Male Genitalia.* The apical tooth of the styles is very long and smoothly curving, unlike that of any other species in the group. (Pl. V.)

*Host Plants.* This species has been taken on sycamore.

*Distribution.* New York, Arkansas.

## *Erythroneura mediana* Robinson.

*Erythroneura mediana* Robinson. Can. Ent., vol. LVI, No. 7, p. 156; 1924.

*Color Pattern.* Vertex, five yellow spots more or less outlined in red and arranged two on anterior and two on posterior margins and one central. Pronotum whitish, with a median Y-shaped vitta and two lateral spots reddish. Scutellum yellow, with an orange spot outlined in red in each basal angle, and tip red. Tegmina opaque-white with the following red marks: Clavus, a spot near base, another near tip and a larger area about the middle, the latter of which having the anterior margin concave and posterior convex. Corium, a spot near base, an oblique streak running from front of costal plaque to near the spot in tip of clavus. Longitudinal veins throughout greater part of their length, and also cross-veins streaked or dotted with red. A black spot in base of cell $M_4$.

*Inner Male Genitalia.* The apical tooth of the styles is long and straight except at the base which bears an upward barb. The pygofer hooks are especially long. The dorsal part of the œdagus bears a somewhat triangular projection. (Pl. V.)

*Distribution.* Kansas.

## *Erythroneura hymac* Robinson.

*Erythroneura hymac* Robinson. Can. Ent., vol. LVI, No. 3, p. 60; 1924.

*Color Pattern.* Vertex, two ivory spots on anterior margin and three on posterior, the middle spot faintly encircled with red. Pronotum, ivory, faint red Y-shaped median vitta and a red triangular spot behind each eye. Scutellum, a small red spot in each basal angle and with orange or red tip. Tegmina subhyaline, with eight faint orange spots arranged almost equidistantly as follows: Three on clavus and five on corium; a small black spot behind the region of costal plaque and one in base of cell $M_4$; cross-veins more or less reddish.

*Inner Male Genitalia.* The pygofer hooks turn abruptly upward at one-third of their length from the base and continue in a long tapering hook. (Pl. IV.)

*Distribution.* Kansas.

## *Erythroneura osborni* De Long.

*Typhlocyba osborni* De Long. Bul. No. 17, vol. V, No. 2, p. 103, Tenn. State Bd. of Ent.; 1916.

*Erythroneura maculata* var. *osborni* McAtee. Trans. Am. Ent. Soc., XLVI, p. 300; 1920.

*Color Pattern.* "Very pale yellowish or white, vertex and face unmarked, pronotum with yellowish spot behind each eye, and an orange crescent-shaped spot, posteriorly convex on disc. Scutellum white. Elytra with a broad blood-red band on basal third of elytra, evenly colored, often not reaching costa. A black spot at the middle of costal margin, another on the inner margin be-

fore the cross nervures of the apical cells and a red one before the nervures on the costal margin." (De Long.)

*Inner Male Genitalia.* The apical half of the pygofer hooks is much enlarged and is terminated by a short tooth. The apex of the styles has a strong lateral projection and bears no visible tooth. (Pl. IV.)

*Distribution.* Tennessee, Illinois.

## *Erythroneura trivittata* Robinson.

*Erythroneura trivittata* Robinson. Can. Ent., vol. LVI, No. 3, p. 59; 1924.

*Color Pattern.* Vertex creamy yellow, with very pale red marks outlining three yellow spots on posterior margin. Pronotum yellow on anterior and greyish on posterior margins, with a small red spot on the latter behind each eye. Scutellum deep blood red. Tegmina, maroon band across base; in the apical third of clavus but not involving the tip a small red band which is continued on to the corium, where it broadens abruptly to about twice the width and the color deepens to a dark maroon; an almost square blue area in the region of the costal plaque carries the band across to the costal margin; cross-veins and parts of adjacent longitudinal veins red; a smoky area extending from the base of cell $M_4$ to the apex of cells $R_3$ and $R_1$.

*Inner Male Genitalia.* The œdagus bears four projections, which resemble dorsally a Greek cross. At the base of the pygofer hooks are two ventral finger-like processes. (Pl. IV.)

*Distribution.* Kansas.

## *Erythroneura univittata* Robinson.

*Erythroneura univittata* Robinson. Can. Ent., vol. LVI, No. 7, p. 156, 1924.

*Color Pattern.* General ground color of anterior parts yellowish-white, of tegmina whitish-hyaline, with following marks in very pale rose: Vertex, streaks outlining a median vitta and two lateral spots. Pronotum, a median and two smaller lateral spots. Scutellum, a spot at tip. A band arising in front of costal plaque and extending across tegmen, widening as it proceeds inward. A spot at tip of clavus and a streak along cubitus. A black spot behind costal plaque and another in base of cell $M_4$.

*Inner Male Genitalia.* The pygofer hooks are exceptionally long and curve downward soon after leaving the heavy base and forward shortly before the terminal tooth. (Pl. IV.)

*Distribution.* Kansas.

*Erythroneura basilaris* Say is a well-marked species, especially the dark or typical form. Two varieties occur which lack the dusky area over the base of the tegmina.

### KEY TO VARIETIES OF *BASILARIS*.

| | | PAGE |
|---|---|---|
| A. | Color markings, in part, red to sanguineous. | |
| B. | Basal tegminal band sanguineous to dusky. | var. *basilaris*.. 128 |
| BB. | Basal tegminal bank pinkish, other markings chiefly yellow. | var. *dulcis*.. 128 |
| AA. | All color markings yellow. | var. *affinis*.. 128 |

## *Erythroneura basilaris* Say.

*Tettigonia basilaris* Say. Journ. Acad. Nat. Sc., Phila., IV, p. 344; 1825. Reprint Compl. Writings II, p. 260; 1859.

*Typhlocyba comes* var. *basilaris* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 760; 1898.

*Color Pattern.* Ground color yellowish-white. Vertex and anterior part of pronotum sometimes marked with light red, but frequently clouded over with a dark smoky band which involves the posterior part of pronotum, scutellum and basal half of tegmina. Inner basal angle of clavus whitish; apical half of tegmina marked with yellow or red. Cross-veins red; a black spot in base of cell $M_4$.

*Inner Male Genitalia.* (Pl. V.)

*Host Plants.* This species has been found breeding on American elm and wild plum.

*Distribution.* Ontario, New York, Connecticut, Virginia, Tennessee, Ohio, Illinois, Wisconsin, Iowa, Nebraska, Kansas.

## *Erythroneura basilaris* var. *dulcis* McAtee.

*Erythroneura basilaris* var. *dulcis* McAtee. Trans. Am. Ent. Soc., XLVI, p. 296; 1920.

*Color Pattern.* "Tegminal band pinkish, tegminal spots yellow, markings on scutellum and anterior parts transculent to livid." (McAtee.)

*Distribution.* Maryland, Kansas.

## *Erythroneura basilaris* var. *affinis* Fitch.

*Erythroneura affinis* Fitch. N. Y. St. Cab. Nat. Hist., p. 63; 1851. Lintner, Reprint, p. 403; 1893. (New York.)

*Color Pattern.* "Tegminal band yellowish brown, other color markings yellow, those on anterior part of pronotum and on vertex sometimes obsolete." (McAtee.)

*Distribution.* Kansas.

*Erythroneura ligata* McAtee may be easily distinguished by the "broad zigzag scarlet vittæ on tegmina, which inclose two pale saddle-spots, a smaller one on inner anterior portions of clavi and a larger one, embracing apical third of clavi and adjacent parts of corium." (McAtee.)

KEY TO VARIETIES OF *LIGATA*.

A. Head and pronotum with faint yellow markings, tip of clavus unmarked. PAGE var. *ligata*.. 128

AA. Head and pronotum with red markings, tip of clavus with a red spot. var. *allecta*.. 129

## *Erythroneura ligata* McAtee.

*Erythroneura ligata* McAtee. Trans. Am. Ent. Soc., XLVI, p. 301; 1920.

*Color Pattern.* "Ground color of scutellum and anterior parts ivory white, of tegmina whitish-hyaline. Vertex with transculent to yellow spots, arranged as in *E. hartii*, three on transition from vertex to front, and four between eyes, of which the central pair are larger and may be connected with lateral spots or with posterior margin of vertex. Pronotum with two broad

lateral, and two narrower discal vittæ, which may be broken into smaller anterior and larger posterior spots, transculent to yellow. Scutellum with yellow basal triangles outlined by scarlet, apex yellow. Tegmina with broad zigzag scarlet vittæ which inclose two pale saddle-spots, a smaller on inner anterior portions of clavi and a larger embracing posterior third of clavi and adjacent parts of corium; the anterior part of each vitta is confined to clavus, and the posterior part, after angling laterally to costal plaque, returns to radial margin and ends abruptly at the cross-veins, a lateral prolongation following them to costal margin; a faint yellow dot at base of corium, usually an oblique yellow streak on anterior margin of costal plaque, plaque itself whitish, a black or bluish dot at its posterior margin, a dusky cloud in base of fourth apical cell, apical cells in general slightly fumose." (McAtee.)

*Inner Male Genitalia.* (Pl. V.)

*Distribution.* District of Columbia, Illinois, Kansas.

### *Erythroneura ligata* var. *allecta* McAtee.

*Erythroneura ligata* var. *allecta* McAtee. Trans. Am. Ent. Soc., XLVI, p. 302; 1920.

*Color Pattern.* "Like typical variety, except that yellow markings of pronotum, vertex and costal margin are replaced by red; apex of scutellum and a spot near tip of clavus also red; touches of red on pleura and face in some specimens." (W. L. McAtee.)

*Distribution.* District of Columbia, Illinois, Kansas.

## THE *COMES* GROUP.

This is the largest and most intricate group in the genus. It may be separated from the preceding by the square base of cell $M_4$ (Pl. I); and the presence of a black spot or cloud in the apex of cell $R_3$ and base of cell $M_4$. The pygofer hooks of the inner male genitalia are very characteristic of the group. Each forms a U-shaped process lying on its side with caudally directed arms (Pl. I), the lower arm always being the longer. There is a considerable range of variation in these hooks within the group, but the characteristic U-shape is retained throughout.

In color pattern there is a very wide range, from an almost solid velvety-black, as in *infuscata,* to a milky white as in *lacta,* and from cross-bands to oblique longitudinal vittæ. There occurs, however, with more or less distinctness throughout the group, an inverted V- or U-shaped mark upon the vertex and a Y-shaped mark upon the pronotum. The group includes twenty-seven species and fourteen varieties.

## KEY TO SPECIES.

PAGE

A. Chief color markings of upper surface one or more transverse bands.
  B. Bands three in number.
    C. Anterior crossband covering bases of tegmina; bands broad.
      D. Vertex and pronotum narrower, the latter not broader than long, pronotum uniformly deep maroon. *rubranotum*.. 137
      DD. Vertex and pronotum broader, the latter about one and one-half times broader than long, pronotum red to dusky, frequently with whitish marks on anterior margin. *vitis*.. 143
    CC. Anterior crossband not covering bases of tegmina; bands narrower. *tricincta*.. 139
  BB. With one band. This band is reddish to dusky and extends over basal half of tegmina, involving tip of scutellum, most of clavi, and area between clavi and costal plaques. *amanda*.. 137
AA. Chief color markings of upper surface otherwise.
  B. Upper surface almost completely smoky-brown to black. *infuscata*.. 136
  BB. Upper surface not as above.
    C. A dark angulate stripe the length of dorsum, pointed on vertex and broad over tegmina. *aclys*.. 135
    CC. Coloration otherwise.
      D. Tegminal markings angulate vittæ, continuous from humeri to crossveins.
        E. Tip of clavus spotted.
          F. Vitta extending from humerus to costal plaque, thence to crossveins; upper surface from scutellum to crossveins occupied by a pale diamond-shaped area with red to yellow spots. *cancellata*.. 141
          FF. Vitta extending from humerus on to the clavus, leaving a pale area anterior to the costal plaque.
            G. A single median vitta on vertex; median vitta on pronotum weakly bifurcate anteriorly.
              H. Larger species, 3 mm. in length; vittæ bright red; a large yellow spot around tip of clavus; ground color yellowish. *fraxa*.. 147
              HH. Smaller species, 2.5 mm. in length; vittæ sanguineous; a red spot at tip of clavus; ground color whittish diffused with red. *kanwakæ*.. 143
            GG. Two vittæ, if any, forming an inverted V-shaped mark on vertex; median vitta on pronotum more strongly bifurcate anteriorly.
              H. Vittæ on tegmina and sides of pronotum broader and sanguineous to dusky.
                I. Tip of clavus lighter than main tegminal vittæ; sides of pronotum heavily marked; main tegminal vittæ of nearly uniform width throughout. *ziczac*.. 135
                II. Tip of clavus about the same color as main tegminal vittæ; sides of pronotum lightly marked; main tegminal vittæ varying in width. *portea*.. 142
              HH. Vittæ on tegmina and sides of pronotum narrower and bright red.
                I. Scutellum marked with two conspicuous black spots at base. *coloradensis*.. 134
                II. Scutellum without black spots at base.
                J. Mesosternum glossy-black; eyes grey to fuscous. *vitifex*.. 134
                JJ. Mesosternum yellowish-white; eyes black. *beameri*.. 141

EE. Tip of clavus unmarked. PAGE

F. Tegminal markings narrower, bright red, and of nearly uniform width throughout; an unusually short and slender species. *acuticephala*.. 146

FF. Tegminal markings broader, pale red to sanguineous, outlined by brighter red, greatly broadened between the costal plaques. *elegans*.. 137

DD. Tegminal markings otherwise, not continuous from humeri to crossveins.

E. Chief tegminal markings consisting of an elongate vitta in basal half of clavus and spot at tip, an oblique streak in base of corium, an angulate vitta more or less completely bordering inner margins of costal plaque.

F. Upper surface of abdomen blackish and showing through tegmina.

G. Vertex yellowish-white with a median inverted V- or U-shaped vitta of red or yellow.

H. All vittæ on upper surface very broad and bright red, giving the insect a characteristic red appearance. *rubra*.. 135

HH. Upper surface not so marked.

I. Clavus bearing a large black spot near middle. *cherokee*.. 142

II. Clavus without black spot. *omaska*.. 146

GG. Vertex red, with eight yellowish-white spots which are sometimes fused to make four longitudinal vittæ.

H. Vertex broader and more acutely pointed; tegmina semihyaline; dorsal markings bright red. *corni*.. 138

HH. Vertex narrower and more rounded at apex; tegmina white; dorsal markings pale red. *ontari*.. 136

FF. Upper surface of abdomen yellowish-white.

G. Tegminal vittæ red or yellow, distinct; crossveins about same color as vittæ. *comes*.. 131

GG. Tegminal vittæ orange, without definite margins, the whitish ground color being diffused with pale orange; crossveins brilliant crimson. *aza*.. 138

EE. Chief tegminal markings otherwise.

F. Middle of clavus with a conspicuous triangular area; base and tip frequently bearing a small spot.

G. Black spot in triangular area of clavus.

H. Ground color of tegmina milky-white; markings red. *scripta*.. 147

HH. Ground color greenish-brown on anterior half, remainder whitish; markings brownish to red. *tudella*.. 138

GG. Without such black spot. *lacta*.. 146

FF. Middle of clavus without triangular area; tegminal markings made up of dots situated chiefly in the region of the longitudinal veins and at the humeri. *irrorata*.. 143

*Erythroneura comes* Say, one of the most commonly occurring species, probably is listed in every collection of *Erythroneura*. Several species, however, somewhat resemble *comes* in color pattern and may be very easily confused with it; and it might not be unacceptable to sound a note of warning in this respect. I have examined

collections labeled *comes* which contained as many as eight different species. The latitude taken in classifying members of this genus is almost certainly due to the prevalent idea that extensive variations exist within the genus. It is now demonstrated that there is considerably less variation than has been supposed, and that forms having even a slight difference in color pattern may be found, when the inner male genitalia are examined, to be distinct species.

As many as twenty varieties of *comes* have been described. McAtee (1920)[6] raised five of these varieties to specific rank, on the characters of wing venation and color pattern. This was confirmed in the same year by Lawson[7] in his study of the inner male genitalia. The number of varieties is now reduced to four, and possibly less, as I have not been able to examine the inner male genitalia of one of the forms left as a variety, namely, *venusta* McAtee, which probably should be raised to specific rank.

KEY TO VARIETIES OF *COMES*.

| | | PAGE |
|---|---|---|
| A. | Scutellum and clavi lacking black markings. | |
| B. | Ground color whitish-hyaline or yellowish-white. | *comes*.. 132 |
| BB. | Ground color milky-white, nearly opaque. | var. *delicata*.. 133 |
| AA. | Scutellum or clavi, or both, with dark markings. | |
| B. | Tegminal vittæ dusky, interrupted behind costal plaque by a broad transverse whitish-hyaline area; pronotum and basal triangles of scutellum ruby-red, apex of scutellum narrowly margined with black. | var. *venusta*.. 133 |
| BB. | Tegminal vittæ or spots red to yellow. | |
| C. | Scutellum without dark markings; spots on inner margins of clavi black. | var. *octonotata*.. 133 |
| CC. | Scutellum with dark markings consisting of a median vitta or a spot at apex. | var. *compta*.. 133 |

## *Erythroneura comes* Say.

*Tettigonia comes* Say. Jour. Acad. Nat. Sci., Phila., IV, p. 343; 1825. Compl. Writ. II, p. 259; 1859.

*Color Pattern.* Ground color of vertex, pronotum and scutellum yellowish-white, of tegmina white to semi-hyaline, and marked with red or yellow as follows: Vertex, an inverted U-shaped median vitta and a small ring along the posterior margin opposite each eye. These marks are sometimes rather irregular in outline; however, they tend to enclose three yellowish-white areas, the middle one of which is twice as long as the lateral ones. Pronotum, a Y-shaped median vitta and a lateral elongated area behind each eye. Scutellum, a spot or outline of one in each basal angle and a small dot at tip. Tegmina, an elongate vitta, abruptly swollen at tip and projecting inward to the tegminal suture, in basal half of clavus, a spot at apex; on corium, an oblique streak near base, a line arising before costal plaque, proceeding inward along the inner margin of plaque to its apex and thence to base of cell $M_4$. Midway along the inner margin of costal plaque there is usually a short, broad extension which approaches to, but does not connect with, the claval vitta. The

[6] W. L. McAtee: Trans. Am. Ent. Soc., XLVI, 267-322; 1920.
[7] Lawson, P. B.: Kans. Univ. Sc. Bul., vol. XII, No. 1; 1920.

corial and claval vittæ therefore do not form a continuous line from humerus to cross veins. Cross veins and adjacent parts of longitudinal veins same color as dorsal markings. Costal plaque opaque-white, but frequently scaled off; an oblique black streak at apex; a black spot in apex of cell $R_3$ and base of cell $M_4$.

*Inner Male Genitalia.* (Pl. VI.)

*Host Plants.* Grape, cultivated and wild. While it is a very general feeder in the spring and late autumn, in the absence of grape foliage, it is not known to breed upon any plant but the grape.

*Distribution.* This is a wide-spread species and occurs practically everywhere the grape is grown.

### *Erythroneura comes* var. *octonotata* Walsh.

*Erythroneura octonotata* Walsh. The Prairie Farmer (Illinois), p. 149; 1862.

*Color Pattern.* Same as *comes* and having in addition a black spot on the middle of the inner margin of the clavus. The color markings are sometimes yellow instead of red.

*Host Plants.* Grape.

*Distribution.* Ontario, New York, Maryland, Mississippi, Michigan, Illinois, Kansas, California.

### *Erythroneura comes* var. *compta* McAtee.

*Erythroneura comes* var. *compta* McAtee. Trans. Am. Ent. Soc., XLVI, 267-322; 1920.

*Color Pattern.* Same as *comes,* but having in addition a black spot on the middle of the inner margin of the clavus and another near tip of scutellum.

*Host Plants.* Grape.

*Distribution.* Ontario, Maryland, Virginia, Alabama, Mississippi, Michigan, Indiana, Illinois, Kansas.

### *Erythroneura comes* var. *delicata* McAtee.

*Erythroneura comes* var. *delicata* McAtee. Trans. Am. Ent. Soc., XLVI, p. 317; 1920.

*Color Pattern.* "Ground color opaque milky white, with red or yellow color markings of the *comes* type, the spots usually small and well separated." (McAtee.)

*Distribution.* Maryland.

### *Erythroneura comes* var. *venusta* McAtee.

*Erythroneura comes* var. *venusta* McAtee. Trans. Am. Ent. Soc., XLVI, p. 319; 1920.

*Color Pattern.* "Vertex chiefly dusky, narrow anterior border and median streak pale yellow; thorax and basal triangles of scutellum deep ruby-red, apex black; broad dusky vitta on tegmen occupying anterior two-thirds of clavus and an oblique area on corium from clavus to black marking on costal plaque; tegmen from posterior edge of this band to cross veins whitish-hyaline; apical cells chiefly dusky; under surface pale yellow." (McAtee.)

*Distribution.* Maryland.

## *Erythroneura vitifex* Fitch.

*Erythroneura vitifex* Fitch. Insects Infesting Fruit Trees. Trans. N. Y. State Agr. Soc., XXI, p. 392; 1856.

*Color Pattern.* General ground color creamy-white and marked with red as follows: An inverted V-shaped vitta upon vertex; a Y-shaped median and two lateral vittæ upon pronotum; scutellum with a red spot in each angle; on tegmina a zigzag vitta extending from humerus midway along clavus, thence over the costal plaque and base of cell $M_4$, tip of clavus red; cross-veins red; apical cells dusky; an oblique black streak in apex of costal plaque; a black spot in base of cell $M_4$.

Frequently this species is marked with yellow instead of red on anterior parts.

*Host Plants.* Grape.

*Inner Male Genitalia.* The genitalia differ markedly from those of *comes* in several particulars. (Pl. VI.)

*Distribution.* Ontario, New York, Virginia, Michigan, Indiana, Illinois, Wisconsin, Iowa, Kansas, Texas, New Mexico.

This species is sometimes confused with *comes,* which, however, it does not closely resemble, as its tegminal color markings consist of a continuous vitta from humerus to cross veins, while those of *comes* are interrupted. The position of this form within the genus has been a changeable one, being regarded at times as synonymous with *comes* or as one of its varieties. However, its inner male genitalia prove it to be a distinct species. There is a close resemblance in color pattern between *vitifex* and *cherokee.* These two species, which show outstanding differences in their inner male genitalia, may be separated readily by the fact that in the former the mesosternum (visible between the first and second pairs of legs) is glossy-black while in the latter it is yellowish-white.

## *Erythroneura coloradensis* Gillette.

*Typhlocyba vitifex* var. *coloradensis* Gillette. Colo. Agr. Exp. Sta., Bul. 19, p. 16; 1892.

*Color Pattern.* Resembles *vitifex,* and has in addition two black spots in the base of the scutellum.

*Inner Male Genitalia.* This is quite characteristic, and differs greatly from *comes* and *vitifex.* (Pl. VI.)

*Host Plants.* Grape.

*Distribution.* Illinois, Nebraska, Kansas, Colorado, New Mexico, California.

This form, which has been regarded as a variety of both *comes* and *vitifex,* is here raised to specific rank.

## *Erythroneura ziczac* Walsh.

*Erythroneura ziczac* Walsh. The Prairie Farmer (Illinois), 10, No. 10, p. 149; 1862.
*Typhlocyba comes* var. *ziczac* Gillette. Proc. U. S. Nat. Mus., p. 761; 1898.

*Color Pattern.* Vertex yellow, pronotum yellow on anterior half and darker behind, a broad brown mark on lateral margins; scutellum yellow with a brown spot in basal angles; tegmina, a broad brown vitta extending from humerus to middle of clavus, then to costal plaque and to base of cell $M_4$; tip of clavus yellow; an oblique black streak at apex of costal plaque; a black dot in apex of cell $R_3$ and a smoky area in base of cell $M_4$; apical cells dusky.

*Inner Male Genitalia.* (Pl. VII.)

*Host Plants.* Grape, Virginia creeper, Boston ivy (*Ampelopsis* spp.).

*Distribution.* Ontario, Maryland, Michigan, Illinois, Mississippi, Iowa, Nebraska, Kansas, Colorado, California.

This species appears to have an especial preference for *Ampelopsis*, and because of the smoothness of the under surface of the foliage the eggs laid under the epidermis may be seen readily, frequently surrounded by a bluish-gray deposit. They are commonly laid side by side in groups of from three to eight. I have never seen *comes* lay eggs other than singly and well separated.

This form is here again raised to specific rank.

## *Erythroneura rubra* Gillette.

*Typhlocyba comes* var. *rubra* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 764; 1898.

*Color Pattern.* Similar in formation to *comes*, but the vittæ are very much broader and of a bright red or scarlet color, sometimes outlined in deep crimson.

*Inner Male Genitalia.* (Pl. VI.)

*Host Plants.* Grape.

*Distribution.* Maryland, Virginia, South Carolina, Tennessee, Illinois, Iowa, Kansas.

This form is here raised to specific rank.

## *Erythroneura aclys* McAtee.

*Erythroneura aclys* McAtee. Trans. Am. Ent. Soc., XLVI, p. 290; 1920.

*Color Pattern.* "Consisting of a broad brown to black stripe extending whole length of insect, margined by pale yellow. The dorsal stripe nearly black on scutellum and anterior parts sharply cut off from a pale yellow margin about the width of eye; on tegmina the stripe is smoky brown, greatly expanded and irregularly set off from the pale yellow costal margin, percurrent to second apical cell, which is about the width of costal plaque; the latter has a slight opaque whitish coating, is margined interiorly and anteriorly by reddish, and underlaid posteriorly by blackish; there are touches of red upon apex of clavus and first cross vein and more or less hyaline spots at extremities of apical third of clavus, on the corium nearby and in middle of fourth apical cell. The legs, pleura and face, vary from flesh color to pale yellow, and the

venter is pale yellow with a median series of slaty spots, the posterior ones extending entirely across last abdominal segment and across base of genitalia; dorsum slaty." (McAtee.)

*Inner Male Genitalia.* (Pl. VI.)

*Host Plants.* Redbud (*Cercis canadensis*).[8]

*Distribution.* Connecticut, New Jersey, Maryland, South Carolina, Tennessee, Illinois, Missouri, Kansas, Nebraska.

This species is generally mistaken for *E. infuscata* due to the fact that Gillette's description of the latter is that of *E. aclys*, while his type in the United States National Museum is that of *infuscata*.

### *Erythroneura infuscata* Gillette.

*Erythroneura comes* var. *infuscata* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 764; 1898.

*Color Pattern.* The following description by W. L. McAtee was made from the type in the United States National Museum: "Smoky brown to black above, in some cases underlaid by deep dull red, a little paler at rondure of vertex, especially on sides, pronotum sometimes faintly paler on disc, and scutellum sometimes with a pale median vitta; tegmina with more or less hyaline spots at base, middle and apex of inner margin of clavus, middle of radial margin of fourth apical cell and on costal margin of second apical cell; costal plaque opaque whitish, tinged with red, an almost equal area of dull red just posterior, and costal margin and to some extent the cross veins penciled with dull red. Face and legs pale yellow, more or less tinged or marked with red, remainder of under surface slaty, abdominal incisures, etc., sometimes pale yellow."

*Inner Male Genitalia.* Pl. VIII.

*Distribution.* Maryland, Mississippi, Illinois, Kansas.

The original description of this form by Gillette in the work noted above is not the description of his type in the United States National Museum, but that of another species, namely, *aclys* McAtee. A certain amount of confusion has arisen because of this discrepancy.

### *Erythroneura ontari* Robinson.

*Erythroneura ontari* Robinson. Can. Ent., vol. LVI, No. 3, p. 60; 1924.

*Color Pattern.* Vertex yellow, chief red markings being a median and two lateral thin streaks. Ground color of pronotum, scutellum and tegmina greyish-white faintly marked with red, as follows: Pronotum with heavy Y-shaped median vitta, and a streak on each side behind the eyes; scutellum with a spot in basal angles and at tip. Tegmina marked as follows: A broad vitta on clavus in touch with basal half of claval suture and barbed at caudal end, and a spot in apical third; corium with a broad stripe, with five lateral extensions running the entire length of cubitus, the three inner ones extending toward the claval suture at its base, middle and tip respectively, and the two

8. H. B. Weiss and E. West: Ent. News, vol. XXXV, No. 4, p. 129; 1924.

outer ones touching the anterior and posterior parts respectively of the costal plaque; red streaks between costal plaque and red cross veins; base and tips of cells smoky.

*Inner Male Genitalia.* This species has a long and curved lower arm to the pygofer hooks, a long slender œdagus, and a truncate, abruptly curved apex to the styles. (Pl. VIII.)

*Distribution.* Ontario, Canada.

## *Erythroneura amanda* McAtee.

*Erythroneura comes* var. *Amanda* McAtee. Trans. Am. Ent. Soc., XLVI, p. 319; 1920.

*Color Pattern.* "Apical third, or at least the sides of scutellum, apically, dusky to black; anterior two-thirds of clavus and a band between clavus and costal plaque bright red; subsidiary markings of tegmen tending to be red anteriorly and yellow posteriorly; markings of head and pronotum yellow." (McAtee.)

*Inner Male Genitalia.* The apical process of the œdagus is divided into four spines. This feature alone is sufficient to give this form specific rank. (Pl. VII.)

*Host Plants.* Grape.

*Distribution.* Missouri, Kansas.

## *Erythroneura rubranotum* Robinson.

*Erythroneura rubranotum* Robinson. Can. Ent., vol. LVI, No. 3, p. 60; 1924.

*Color Pattern.* Vertex ivory, with apex and two small spots on base faintly red. Pronotum and basal half of scutellum deep maroon; tip of scutellum white. Tegmina, ground color light yellow, red band across base, a wide red band with darker markings occupying apical half, excepting tip, of clavus and extending over corium to an elongate brown area in the region of costal plaque; cross veins red, apical cells smoky.

*Inner Male Genitalia.* (Pl. VI.)

*Distribution.* Kansas.

## *Erythroneura elegans* McAtee.

*Erythroneura comes* var. *elegans* McAtee. Trans. Am. Ent. Soc., XLVI, p. 315; 1920.

*Color Pattern.* "This variety (species) differs from *vitifex* in having broader tegminal vittæ, pale bluish-red to dusky within, brighter margined, which are in touch for a greater distance along the commissure (at middle of clavus); the posterior pale spot inclosed by them is less extensive and the tips of the clavi are not marked with red." (W. L. McAtee.)

*Inner Male Genitalia.* (Pl. VIII.)

*Host Plants.* Grape; Boston ivy (*Ampelopsis* spp.).

*Distribution.* Ontario, Pennsylvania, Maryland, Mississippi, Arkansas, Indiana, Illinois, Iowa, Nebraska, Kansas, Colorado.

This species differs considerably from *comes* in color pattern, habits, and particularly inner male genitalia; and is therefore raised to specific rank.

## *Erythroneura corni* Robinson.

*Erythroneura corni* Robinson. Can. Ent., vol. LVI, No. 3, p. 60; 1924.

*Color Pattern.* Vertex brownish-red with two transverse rows of four white spots each, the middle spots connected to form longitudinal vittæ; posterior half often of lighter color. Pronotum, anterior margin yellow, a large brown discal area, a lateral red spot behind each eye; two smoky-grey spots on posterior margin. Scutellum brown, with faint median and transverse line yellow. Tegmina hyaline, with the following pattern in red: On clavus, a vitta in touch with claval suture from the base about one-half the length of the latter, and a spot covering apical third; on corium, a vitta extending from near base of wing to costal plaque, thence inwardly half way around the latter, where it becomes enlarged and almost touches claval suture, then narrows again and continues to the posterior end of the costal plaque, where it forms a "Y" with heavy base, one arm extending to the tip of clavus and the other along cubitus to the red cross veins. Apical cells smoky, except middle of cells $R_3$ and $M_4$. An oblique dark line in apex of costal plaque. The blackish abdomen shows through the tegmina and gives the insect a dark appearance.

*Inner Male Genitalia.* This species has a long and upward curving lower arm to the pygofer hooks; and a long slender œdagus. (Pl. VII.)

*Host Plants.* Dogwood (*Cornus* spp.).

*Distribution.* Kansas, Nebraska.

## *Erythroneura aza* Robinson.

*Erythroneura aza* Robinson. Can. Ent., vol. LVI, No. 12, p. 291; 1924.

*Color Pattern.* Ground color of vertex, pronotum and scutellum ivory, of tegmina white, with the following marks in orange. Vertex, a narrow median inverted U-shaped vitta; pronotum, a broad median Y-shaped vitta and a broad lateral vitta behind each eye; scutellum, a broad spot in each basal angle and a small spot at tip. Tegmina, lightly washed with orange throughout, except at inner basal angle of clavus and in base of corium, where the orange is deepened to nearly red. Cross veins and adjacent parts of longitudinal veins crimson. A black streak caudad of costal plaque; apical cells whitish at base, remainder dusky, especially near the base. A black spot in apex of sell $R_3$ and base of cell $M_4$.

*Inner Male Genitalia.* (Pl. VII.)

*Distribution.* Kansas.

## *Erythroneura tudella* Robinson.

*Erythroneura tudella* Robinson. Can. Ent., vol. LVI, No. 12, p. 291; 1924.

*Color Pattern.* Vertex brownish, eyes black; pronotum fulvous on anterior margin, remainder greenish-yellow; scutellum yellow. Tegmina, ground color of basal third greenish-yellow, of remainder white, and marked as follows: In middle of clavus a brownish-red somewhat triangular area with a black spot in the angle touching the tegminal suture; a brownish-red line arising before the costal plaque and bordering its inner margin, the line then broadens, becomes orange in color and proceeds to the base of cell $M_4$. Costal plaque

opaque-white with an oblique black streak at its apex; apical cells smoky; a black spot in apex of cell $R_3$ and base of cell $M_4$.

*Distribution.* Kansas.

*Erythroneura tricincta* Fitch is one of the most common and easily recognized species, and is recorded as being frequently injurious to grape. Six varieties occur, and may be separated by the following key.

KEY TO VARIETIES OF *TRICINCTA*.

| | | PAGE |
|---|---|---|
| A. | Anterior cross-band involving base of scutellum. | |
| B. | Anterior crossband extending along sides of pronotum, leaving disc uncolored; middle crossband sanguineous to dusky, black on costa. var. *calycula*.. | 140 |
| BB. | Anterior crossband covering all of pronotum except a small part of anterior margin. | |
| C. | Crossbands sanguineous to black. *tricincta*.. | 139 |
| CC. | Crossbands bright red. | |
| D. | Longitudinal color streaks yellow. var. *diva*.. | 139 |
| DD. | Longitudinal color streaks bright red. var. *rubravitta*.. | 140 |
| AA. | Anterior crossband not covering base of scutellum. | |
| B. | Anterior crossband sanguineous to dusky, covering most of pronotum; middle crossband sanguineous to bright red, black on costa; posterior crossband yellow-brown on apical half. var. *integra*.. | 140 |
| BB. | Anterior crossband dusky to black, profoundly emarginate anteriorly, leaving a large part of disc of pronotum uncolored. | |
| C. | Crossband continuous across posterior margin of pronotum. var. *cymbium*.. | 140 |
| CC. | Crossband (?) broadly interrupted, covering only sides of pronotum. var. *disjuncta*.. | 140 |

## *Erythroneura tricincta* Fitch.

*Erythroneura tricincta* Fitch. N. Y. State Cab. Nat. Hist., IX, p. 63; 1851.

*Color Pattern.* The anterior crossband covers all of pronotum except a small area on anterior margin, and basal half of scutellum. The longitudinal color streaks upon the yellowish-white background between the crossbands may be either yellow or red.

*Inner Male Genitalia.* (Pl. VI.)

*Host Plants.* Grape, Boston ivy (*Ampelopsis* spp.).

*Distribution.* Ontario, New York, Vermont, New Hampshire, Pennsylvania, Maryland, Virginia, North Carolina, South Carolina, Tennessee, Ohio, Michigan, Indiana, Mississippi, Illinois, Wisconsin, Iowa, Missouri, Texas, Kansas, Nebraska, Colorado.

## *Erythroneura tricincta* var. *diva* McAtee.

*Erythroneura tricincta* var. *diva* McAtee. Trans. Am. Ent. Soc., XLVI, p. 308; 1920.

*Color Pattern.* "Crossbands one and two chiefly bright red; crossband one covering most of pronotum and base of scutellum, where its color is sometimes brownish-yellow instead of red; crossband two, bright red to costal plaque which is chiefly blackish, more or less overlaid by opaque white; longitudinal color markings sulphur yellow." (McAtee.)

*Distribution.* Maryland, Virginia, Kansas.

## *Erythroneura tricincta* var. *calycula* McAtee.

*Erythroneura tricincta* var. *calycula* McAtee. Trans. Am. Ent. Soc., XLVI, p. 308; p. 1920.

*Color Pattern.* "Ground color ivory, a broad U-shaped dusky to black band on base of scutellum and sides of pronotum, the often concolorous eyes extending in on vertex; crossband two sanguineous to dusky, black on costa; longitudinal color streaks red." (McAtee.)

*Distribution.* Maryland, Illinois, Kansas, Nebraska.

## *Erythroneura tricincta* var. *integra* McAtee.

*Erythroneura tricincta* var. *integra* McAtee. Trans. Am. Ent. Soc., XLVI, p. 309; 1920.

*Color Pattern.* "Crossband one, sanguineous to dusky, confined to pronotum, most of which it covers; crossband two bright red to sanguineous, bluish to black on costa; longitudinal color markings yellow or red." (McAtee.)

*Distribution.* Maryland.

## *Erythroneura tricincta* var. *cymbium* McAtee.

*Erythroneura tricincta* var. *cymbium* McAtee. Trans. Am. Ent. Soc., XLVI, p. 310; 1920.

*Color Pattern.* "Crossband one, dusky to black confined to pronotum, profoundly emarginate anteriorly, leaving a large part of disc uncolored; crossband two sanguineous to red, bluish to black on costa; longitudinal color streaks yellow." (McAtee.)

*Distribution.* Ontario, Pennsylvania, Michigan, Nebraska, Kansas, Texas.

## *Erythroneura tricincta* var. *disjuncta* McAtee.

*Erythroneura tricincta* var. *disjuncta* McAtee. Trans. Am. Ent. Soc., XLVI, p. 310; 1920.

*Color Pattern.* "Like the last, but cross-band (if it may be so called) one, broadly interrupted in the middle, covering only sides of pronotum." (McAtee).

*Distribution.* Pennsylvania, Kansas.

## *Erythroneura tricincta* var. *rubravitta* Robinson.

*Erythroneura tricincta* var. *rubravitta* Robinson. Can. Ent., vol. LVI, No. 7, p. 156; 1924.

*Color Pattern.* Vertex yellow, with median dashes of red. Pronotum maroon, except a small yellow spot in middle of anterior margin. Scutellum deep maroon in basal angles and light red or yellow at tip. Tegmina, ground color yellow with the following marks in red: A broad band across middle ending in the large black area in each costal plaque. In this band the color is pale within and with dark margins. A broad vitta lies in base of clavus and there is a faint spot at tip. There is also a spot in base of corium. Longitudinal veins, especially cubitus, overlaid with red. Cross veins blackish; apical cells, excepting base, smoky to black.

*Distribution.* Kansas.

## *Erythroneura cancellata* McAtee.

*Erythroneura comes* var. *cancellata* McAtee. Trans. Am. Ent. Soc., XLVI, p. 320; 1920.

*Color Pattern.* "Vertex and pronotum dusky sanguineous, the usual vittæ barely distinguishable by their brighter red color; scutellum sanguineous, except broad median pale vitta, and bright red tip; on each tegmen a broad sanguineous vitta from humerus to costal plaque and from costal plaque to cross veins near radial margin; these vittæ inclose (with pale areas on scutellum) a large pale diamond-shaped saddle-spot extending from base of scutellum to cross veins, which is ornamented by bright red markings as follows: Tip of scutellum and of clavus, a V-shaped marking on middle of each clavus, connected by a short oblique streak to longitudinal sanguineous vitta near posterior end of costal plaque. Costal plaque pale yellow, an oblique black streak posteriorly, more or less overlaid by opaque white; costa between plaque and cross veins pale yellow, a ramose red marking on cross veins; apical cells dusky except extreme bases of all, and the central interior of two and four; a little black at base of four and at apices of two and four. Pale yellow below, face with touches of red, and genitalia more or less livid to slaty." (McAtee.)

*Inner Male Genitalia.* (Pl. VII.)

*Distribution.* Maryland, Kansas.

This form is here raised to specific rank.

## *Erythroneura beameri* Robinson.

*Erythroneura beameri* Robinson. Can. Ent., vol. LVI, No. 3, p. 61; 1924.

*Color Pattern.* General ground color creamy-white with the following red markings: Vertex, two posteriorly diverging vittæ making an inverted V-shaped mark; pronotum, a broad Y-shaped vitta with arms and base of about equal width and length, a vitta on each lateral margin; scutellum, a solid spot or outline of one in each basal angle and a spot at the tip; tegmina, on clavus a vitta in touch with basal half of claval suture with a caudal barb which projects forward and inward to meet the tegminal suture, tip of clavus red; on corium an oblique line arising near the humeral angle and meeting the middle of the claval vitta, another which borders front and inner margins of the costal plaque and then proceeds to the base of cell $M_4$. Cross veins red; cells smoky. An oblique dark mark in the apex of costal plaque; a black dot in the apex of cell $R_3$ and base of cell $M_4$.

*Inner Male Genitalia.* (Pl. VI.)

*Distribution.* Kansas.

This species somewhat closely resembles *vitifex* in color pattern, but may be separated by the fact that the mesosternum is yellowish-white instead of black. The great difference in the inner male genitalia of these two forms precludes any possibility of their being the same species.

## *Erythroneura portea* Robinson.

*Erythroneura portea* Robinson. Can. Ent., vol. LVI, No. 7, p. 154; 1924.

*Color Pattern.* General ground color yellowish-white, with the following markings: Vertex, an inverted V-shaped reddish vitta. Pronotum, a slaty-brown area on disk with two reddish arms projecting forward to meet the vitta on vertex; a lateral vitta behind each eye. Scutellum, a yellowish spot outlined in red in each basal angle, and yellow spot at tip. Tegmina, a reddish vitta arising in base of clavus, soon broadening and proceeding across corium to costal plaque, where it becomes as wide as length of plaque, then proceeding inward and dividing into two arms, one of which touches tip of clavus and the other the base of cell $M_4$. This vitta is sometimes paler within and margined in dark red; sometimes bluish within dark red margin; tip of clavus is pale red. Costal plaque yellowish-white with an oblique black or blue streak at apex. Cross veins and adjacent parts of longitudinal veins crimson. Apical cells smoky, except part adjoining cross-veins.

*Inner Male Genitalia.* (Pl. VII.)

*Host Plants.* Grape.

*Distribution.* Ontario, Kansas.

## *Erythroneura cherokee* Robinson.

*Erythroneura cherokee* Robinson. Can. Ent., vol. LVI, No. 7, p. 154; 1924.

*Color Pattern.* Vertex yellow, with a median U-shaped vitta and two lateral streaks reddish. Pronotum yellow on anterior margin and slaty behind; on disk and close to posterior margin a brownish-red area with two hornlike prolongations projecting forward to meet the median vitta on vertex, a wide reddish lateral vitta behind each eye. Scutellum, a yellow spot outlined in brown in each basal angle, a yellow spot at tip, a white inverted T-shaped vitta on disk. Tegmina hyaline, with the following red markings: Basal two-thirds of clavus occupied by a hatchet-shaped vitta, which contains a black spot in its broad end; a spot at tip. On corium, an oblique streak at base, a streak bordering front of white costal plaque and broadening at middle of the inner margin until it touches the claval suture, proceeding backward in a narrowing line to the blue streak at apex of costal plaque, then continuing backward to the base of cell $M_4$. Cross veins and adjacent parts of longitudinal veins crimson; apical veins white; apical cells hyaline bordering cross veins and followed by a dark smoky area, remainder of cells light smoky; a black spot in the apex of cell $R_3$ and base of cell $M_4$.

*Inner Male Genitalia.* The apical process of the œdagus is seen to be divided into two slender spines, when viewed laterally, the inner one being the longer. Each of these spines is in turn divided, and when viewed dorsally the œdagus appears to bear four apical spines. The apex of the styles bears a long slender tooth. (Pl. VIII.)

*Distribution.* Nebraska, Kansas.

## *Erythroneura kanwakae* Robinson.

*Erythroneura kanwakae* Robinson. Can. Ent., vol. LVI, No. 12, p. 292; 1924.

*Color Pattern.* Vertex ivory, with two very narrow vittæ of red which lie closely together and frequently are fused for the greater part of their length. Pronotum ivory in the anterior half, the remainder yellow tinged with grey; a Y-shaped vitta on disk and two lateral lines red. Scutellum yellowish-white, with a red spot in each angle. Tegmina white and marked with red, as follows: On clavus, a vitta in touch with basal two-thirds of claval suture and a spot at tip. On corium, a spot at base, a fine line arising in front of costal plaque, soon broadening and proceeding around inner margin, giving off a short, broad extension to the claval suture and touching claval vitta, then directed inward to the base of cell $M_4$. The corial vittæ are sometimes pale red to dusky within and brightly margined in red; whitish ground color of tegmina frequently diffused with red; a smoky band extends obliquely over apical cells from base of $M_4$ to apex of $R_3$. This is a slender species with a long narrow vertex.

*Inner Male Genitalia.* The pygofer hooks which are characteristically U-shaped in this group are, in *kanwakæ,* somewhat modified by bearing between the two arms an intermediate spine. In this species the pygofer hooks are also especially large. The dorsal part of the œdagus bears two acute and forward projecting teeth. The apices of the styles are abruptly swollen and truncate. (Pl. VIII.)

*Distribution.* Nebraska, Kansas.

## *Erythroneura irrorata* Robinson.

*Erythroneura irrorata* Robinson. Can. Ent., vol. LVI, No. 7, p. 154; 1924.

*Color Pattern.* Vertex red, with a median and two lateral streaks of yellow. Pronotum, anterior part red, with three yellow spots, remainder slaty-grey. Scutellum orange, with darker spots in basal angles and tip. Tegmina hyaline, irrorate with red in region of veins, especially heavy along costal margin. An oblique black streak in apex of costal plaque. Apical cells more or less clouded with fulvous.

*Inner Male Genitalia.* (Pl. VIII.)

*Distribution.* Kansas.

*Erythroneura vitis* Harris is another of the species which commonly infests the grape. It is easily distinguished by its two broad scarlet bands and dusky apical cells. Five varieties have been described.

KEY TO VARIETIES OF *VITIS*.

PAGE

A. Anterior crossband extending beyond apex of scutellum, at least along costal margin; middle crossband usually broader, extending to or beyond apex of clavus.
  B. Middle crossband bounded by nearly or quite interrupted pale bands.
    C. Ground color between crossbands white or creamy-white; crossbands red to dusky. *vitis*.. 144
    CC. Ground color between crossbands deep canary-yellow; crossbands tan to fulvous. var. *flava*.. 144
  BB. Pale areas bounding middle crossband interrupted or replaced by red markings.
    C. Crossband bounded by a wreath of pale spots, about three on each tegmen anteriorly and four posteriorly. var. *corona*.. 145
    CC. Crossband bounded anteriorly by a more or less interrupted pale area, sometimes reduced to a single spot on clavus, and posteriorly broadly joined to red markings on crossveins, leaving a pale area only at and adjacent to apex of clavus; the tegmen therefore chiefly red, sometimes with only two pale areas at base and apex of clavus, which latter the middle crossband usually does not reach. var. *bistrata*.. 145
AA. Anterior crossband not extending beyond apex of scutellum, middle crossband narrower, not reaching apex of clavus. var. *stricta*.. 145

## *Erythroneura vitis* Harris.

*Tettigonia vitis* Harris. Encyclopedia Americana, VIII, p. 43; 1831.
*Typhlocyba comes* var. *vitis* Gillette. Proc. U. S. Nat. Mus., vol. XX, p. 761; 1898.

*Color Pattern.* The following description is by McAtee:[9] "Vertex yellowish with two parallel orange reddish vittæ, broader and deeper colored behind, sometimes almost wholly red; pronotum scarlet with a short median vitta in front, extreme anterior margin, and obsolete discal parentheses, pale yellow; scutellum chiefly scarlet, basal triangles and basal median vitta sometimes pale; tegmen with three crossbands, the anterior scarlet extending well beyond apex of scutellum, the median scarlet (often paler red to dusky within), broad, from middle to near tip of clavus; those on the two tegmina together forming a large roundish saddle spot, sometimes slightly projected along the sectors or connected to anterior band or posterior ramose line at a few points, and terminating laterally at costal plaque, which is blackish posteriorly and sometimes followed by a yellowish area; third crossband made by the blackish apical cells which are hyaline basally; a ramose red line on cross veins and adjoining parts of longitudinal veins."

*Inner Male Genitalia.* (Pl. VIII.)

*Host Plants.* Grape.

*Distribution.* Ontario, Quebec, Maine, New York, Connecticut, Pennsylvania, Maryland, Virginia, Tennessee, North Carolina, South Carolina, Mississippi Ohio, Michigan, Indiana, Wisconsin, Illinois, Missouri, Iowa, Nebraska, Kansas, Colorado.

## *Erythroneura vitis* var. *flava* Robinson.

*Erythroneura vitis* var. *flava* Robinson. Can. Ent., vol. LVI, No. 3, p. 62; 1924.

*Color Pattern.* Vertex, pronotum and scutellum buff, a brownish area on disk of pronotum. Tegmina, ground color canary yellow, light brown band across base, a broader reddish-brown band across middle. Cross veins faintly red; apical cells smoky.

*Distribution.* Minnesota.

9. Trans. Am. Ent. Soc., XLVI; 1920.

## *Erythroneura vitis* var. *corona* McAtee.

*Erythroneura vitis* var. *corona* McAtee. Trans. Am. Ent. Soc., LVI, p. 304; 1920.

*Color Pattern.* "Similar to variety *vitis*, but middle crossband on tegmina connected by red lines along longitudinal veins to anterior crossband and to ramose marking on cross veins, so that the saddle mark appears to be surrounded by a wreath of pale spots." (McAtee.)

*Distribution.* Maryland, Illinois, Kansas.

## *Erythroneura vitis* var. *bistrata* McAtee.

*Erythroneura vitis* var. *bistrata* McAtee. Trans. Am. Ent. Soc., XLVI, p. 305; 1920.

*Color Pattern.* "This variety illustrates the extreme degree of erythrization of this species I have seen; the vertex may be pale yellow, but usually it has the normal pair of vittæ strongly developed, and it may be almost entirely red; the pronotum is red, with touches of pale yellow on anterior border, with a dot in middle, and traces of pale yellow at about two points on the hind margin; scutellum red, with a pale median vitta enlarged at apex; tegmen often entirely red, with the exception of a pale spot at inner base of clavus and another involving apex of clavus and adjoining corium; there may be other traces, however, of both anterior and posterior pale bands, and the costal plaque, except for its posterior blackish marking and an equal sized area behind it and the bases of the apical cells, are pale; under surface and legs chiefly pale yellow. (W. L. McAtee.)

*Distribution.* Maryland, Illinois.

## *Erythroneura vitis* var. *stricta* McAtee.

*Erythroneura vitis* var. *stricta* McAtee. Trans. Am. Ent. Soc., XLVI, p. 305; 1920.

*Color Pattern.* "Ground color whitish-hyaline to pale yellow; vertex chiefly pale, sometimes with a few touches of red, pronotum and scutellum chiefly red to dusky, the latter sometimes pale medianly and at tip; tegmen with three crossbands, the anterior red, narrow, not exceeding scutellum, the middle one narrower than in the other varieties, usually nearly quadrilateral in shape; the posterior much as in last variety, pale spaces between the bands broader than in the other varieties; usually half or more of costal plaque bluish or blackish, often overlaid by opaque-white; lower surface stramineous to pale yellow." (McAtee.)

*Distribution.* Pennsylvania, Maryland, Indiana, Iowa, Kansas, Colorado.

McAtee describes also a yellow form of this variety, which I am including here:

"Vertex, pronotum and scutellum chiefly yellow, the last two more or less overlaid by brownish; tegmen with three crossbands, the anterior yellow to red, involving base of corium not beyond apex of scutellum and narrowly extended along costa, the median broad, semielliptical, red, duller within, terminating laterally in a blackish marking on posterior third of costal plaque; posterior crossband formed by dusky clouds in apical cells; a branching red line on cross veins and adjacent parts of longitudinal veins. Legs and face pale yellow; mesosternum black; body slaty with lighter edgings, varying to wholly pale yellowish."

## *Erythroneura lacta* Robinson.

*Erythroneura lacta* Robinson. Can. Ent., vol. LVI, No. 3, p. 62; 1924.

*Color Pattern.* Vertex, pronotum and scutellum creamy-white. Tegmina opaque-white, relieved by the following color pattern: Vertex, two very pale yellow spots on posterior margin; pronotum, an indistinct yellow Y-shaped vitta; scutellum, a light yellow spot in each basal angle and at tip. Tegmina, on clavus an orange spot at base, a red triangular area at middle, and an orange spot at tip; on corium an orange spot at base, costal plaque bordered on front and inner margins by a narrow orange mark, at the middle of which is a short red extension to meet the claval suture and at its caudal end a faint orange vitta which proceeds in a widening line to base of cell $M_4$. Cross veins more or less reddish; a black spot in the apex of cell $R_3$ and base of cell $M_4$.

*Inner Male Genitalia.* (Pl. VII.)

*Host Plants.* Grape.

*Distribution.* Ontario, Kansas.

## *Erythroneura omaska* Robinson.

*Erythroneura omaska* Robinson. Can. Ent., vol. LVI, No. 3, p. 62; 1924.

*Color Pattern.* Vertex orange, with a median vitta and four lateral spots of yellow. Pronotum white, a Y-shaped median vitta with yellow arms and orange base, a diamond-shaped orange vitta behind each eye. Scutellum creamy, with yellow spots outlined in red in each basal angle and red tip. Tegmina, ground color opaque white, with the following orange markings: On clavus, a vitta in touch with basal half of claval suture, constricted in the middle and barbed at caudal end and a spot at tip; on corium, an oblique streak near the base, a line bordering front and inner margins of costal plaque, in the middle of which is an abrupt extension to the claval suture, then a line proceeding in a widening paler vitta to the base of cell $M_4$. Cross veins vermillion; apical cells, white bordering cross veins and remainder smoky. An oblique dark streak in the apex of costal plaque, and a black spot in the apex of cell $R_3$ and base of cell $M_4$.

*Inner Male Genitalia.* The apical process of the œdagus is long and heavy and strongly bifurcate. The apices of the styles are also very characteristic of this species. (Pl. VII.)

*Distribution.* Kansas.

## *Erythroneura acuticephala* Robinson.

*Erythroneura acuticephala* Robinson. Can. Ent., vol. LVI, No. 3, p. 61; 1924.

*Color Pattern.* General ground color yellowish-white with light red markings as follows: Vertex, a long, very slender inverted U-shaped vitta; pronotum, a slender Y-shaped vitta with short arms and long heavy base, a long vitta on each lateral margin; scutellum, a large spot entirely red or outlined in red in basal angles, a spot at tip. Tegmina, on clavus a vitta beginning half way between humeral and inner basal angles and proceeding half the length of the claval suture, where it becomes enlarged and projects inward and touches the tegminal suture; on corium an oblique vitta beginning about half way between humeral angle and costal plaque and proceeding inward to a

point one-third along the claval vitta, an oblique vitta beginning as a narrow streak in front of the costal plaque, soon widening and proceeding back to the base of cell $M_4$, and connected with the tip of the claval vitta by a short band. Cross veins red; apical cells smoky; an oblique dark mark in the apex of costal plaque; a black dot in the apex of $R_3$ and the base of $M_4$. The marks on the tegmina tend to be lighter colored with darker margins.

*Inner Male Genitalia.* (Plate VIII.)

*Distribution.* Kansas.

This is a slender species with very pointed vertex.

## *Erythroneura scripta* Robinson.

*Erythroneura scripta* Robinson. Can. Ent., vol. LVI, No. 12, p. 290; 1924.

*Color Pattern.* General ground color of dorsum milky-white, except vertex which is ivory-white, and marked with red as follows: Vertex, a large O-shaped median mark to which are joined two smaller lateral ones. Pronotum, a T-shaped vitta with two short lateral spots behind the eyes. Scutellum, a spot in each angle. Tegmina, on clavus a small spot near base, a triangular area at middle with a black spot in the inner angle; on corium, two spots at base which are sometimes fused, an interrupted line around the costal plaque, a spot between the latter and the claval suture, an oblique line running from the black streak at apex of costal plaque to the base of cell $M_4$. Radius and media in region of cross veins red. Apical cells smoky except a clear outline along the base. A black spot in apex of cell $R_3$ and base of cell $M_4$.

*Inner Male Genitalia.* (Pl. V.)

*Distribution.* Kansas.

## *Erythroneura fraxa* Robinson.

*Erythroneura fraxa* Robinson. Can. Ent., vol. LVI, No. 12, p. 292; 1924.

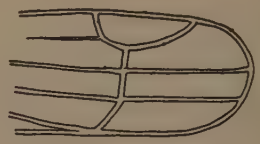
*Color Pattern.* Ground color creamy-white, with the following pattern in red: Vertex, a very broad median vitta, which may consist of two narrow vittæ fused together. Pronotum, a narrower median vitta bifurcate at anterior end, a broader lateral vitta behind each eye. Scutellum, a large triangular area in each basal angle and a small dot at tip. Tegmina, an unusually broad area at the humerus, probably made up of two vittæ fused together; from this a line extends inwardly to the tegminal suture midway along the clavus. Another line arises before the costal plaque as a very fine streak, soon widens greatly and proceeds along the inner margin of the plaque and then inwardly to the base of cell $M_4$. These two lines, the claval and corial, are connected in the region of the costal plaque by a short band and make one continuous vitta from the humerus to the crimson cross veins. Apical cells dusky; a black spot in the apex of cell $R_3$ and base of cell $M_4$.

*Distribution.* Kansas.

PLATE I.

1

Obliqua Group

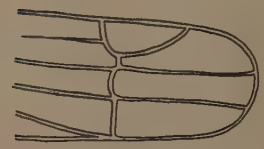


2

Maculata Group

3

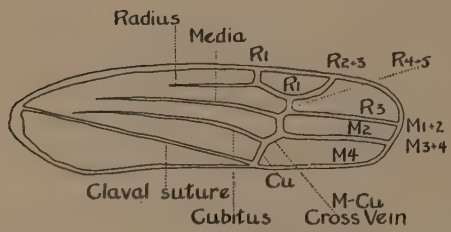
Vulnerata-Scutelleris Group



4

Comes Group

Genus Typhlocyba

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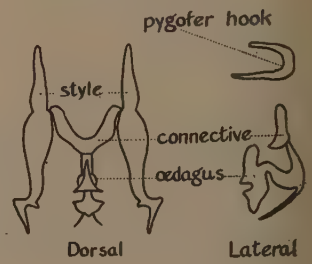


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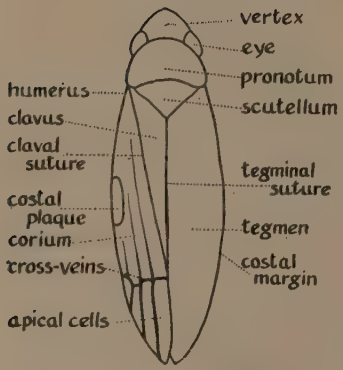


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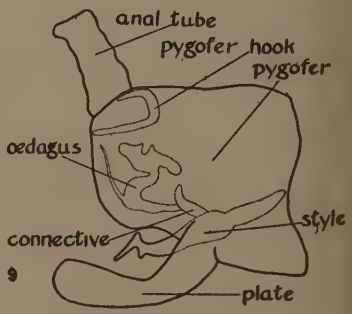


9

PLATE II.

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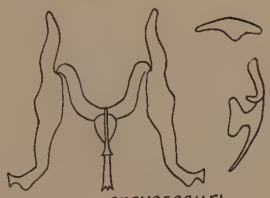
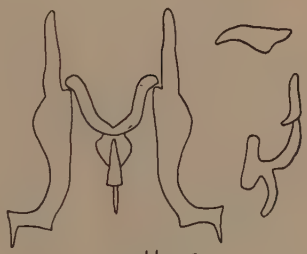

crevecoeuri

kanza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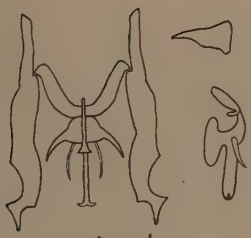
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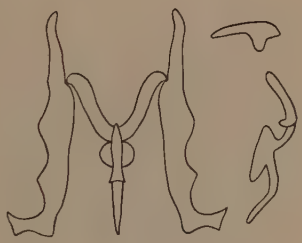

rubroscuta

torra

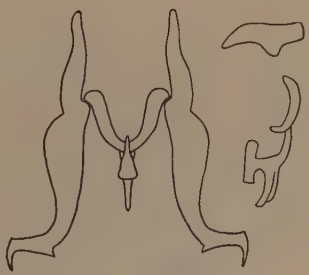
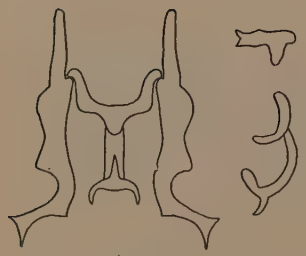

abolla

PLATE III.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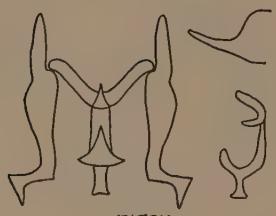
rubraza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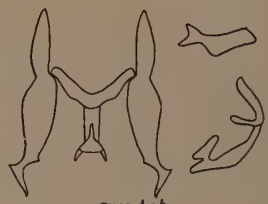
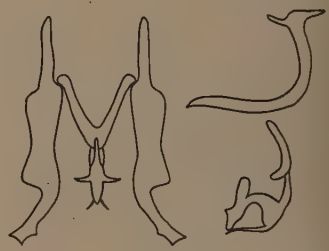

gradata

illinoiensis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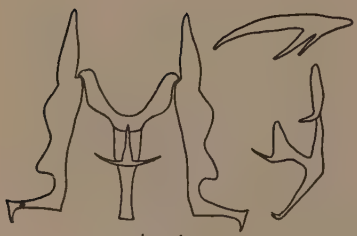
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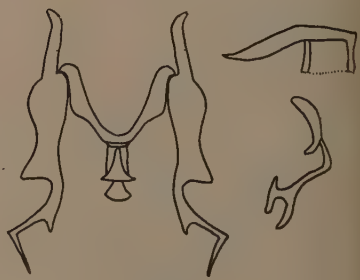
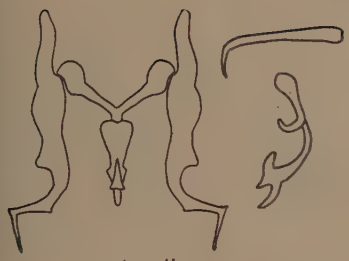

morgani

PLATE IV.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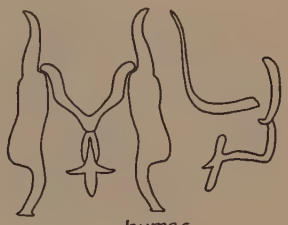
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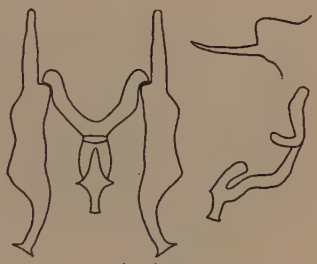
bipunctata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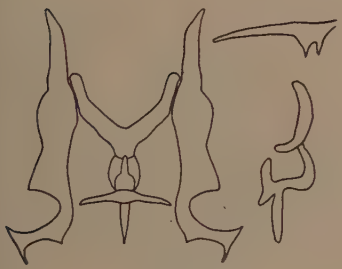
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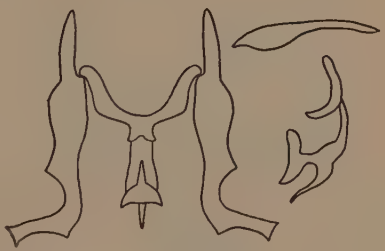
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univittata

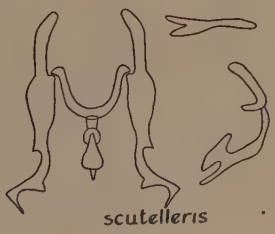
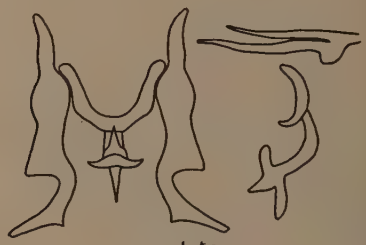

scutelleris

PLATE V.

scripta

basilaris



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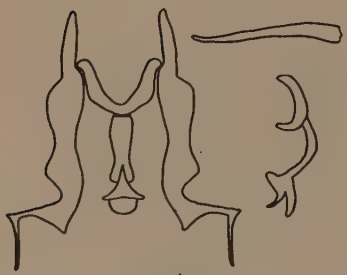

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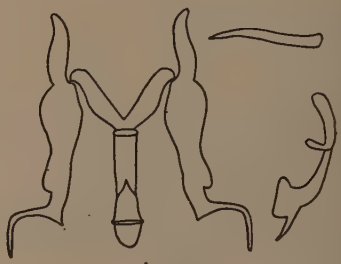

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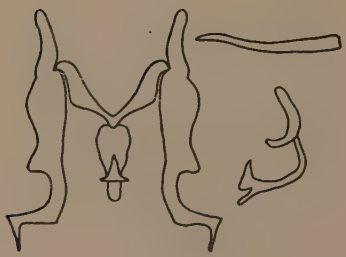

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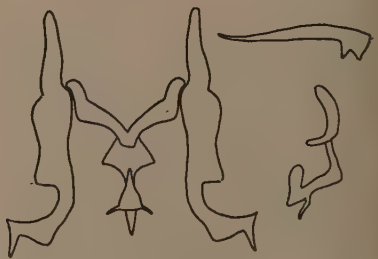
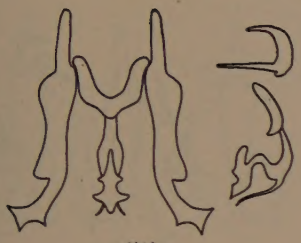


ligata

PLATE VI.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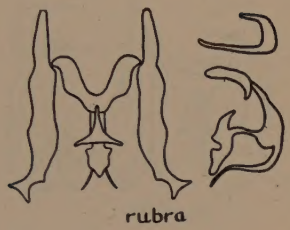
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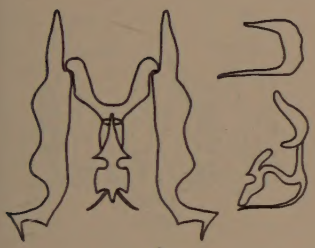
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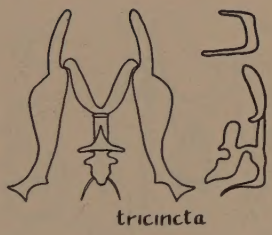
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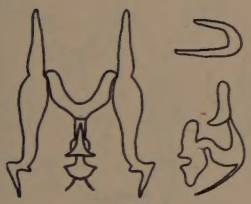
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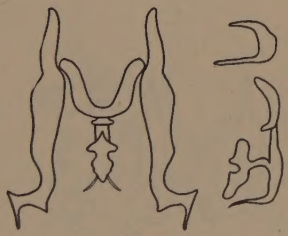
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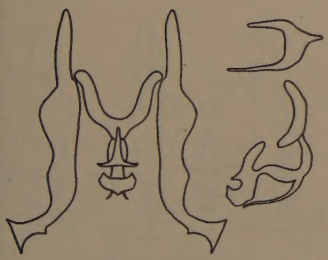
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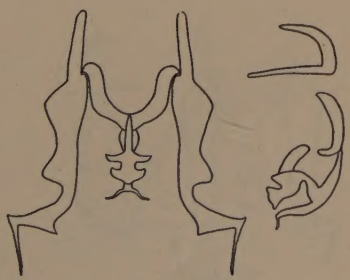
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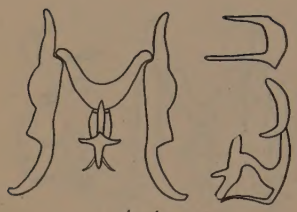
PLATE VII.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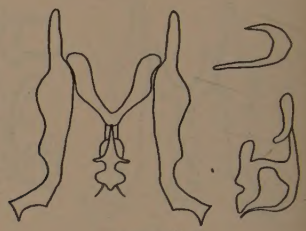
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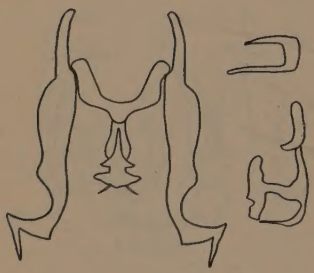
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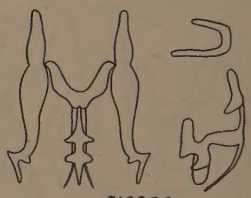
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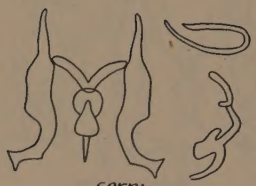
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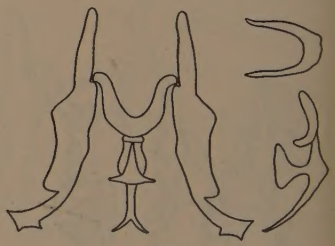
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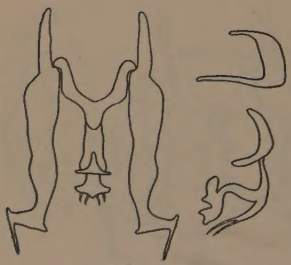
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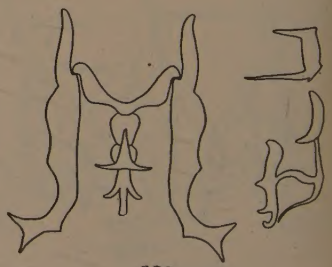
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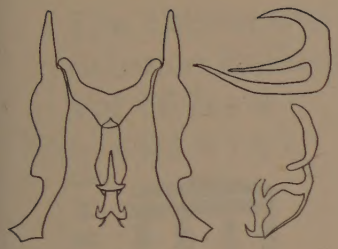
PLATE VIII.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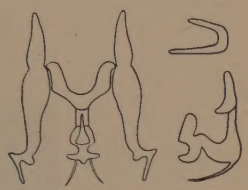
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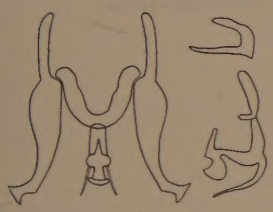
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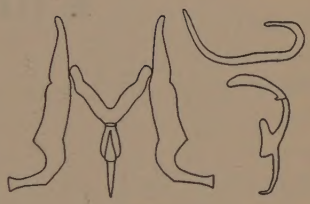
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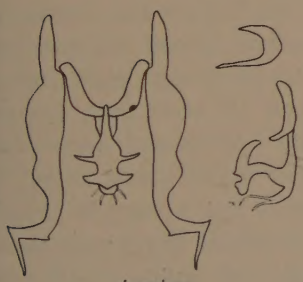
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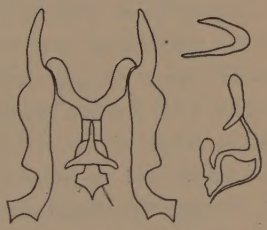
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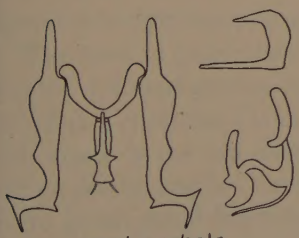
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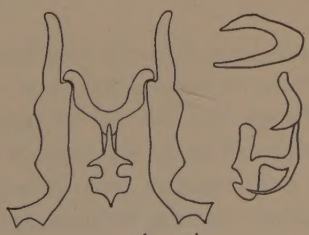
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